Learning kit 6

New educational strategies

Preface

Le Carrefour de la réussite au collegial was created by the Fédération des cégeps to support cégeps in the implementation of programs geared toward student success. The means of achieving this include the organization of conferences, symposiums, thematic workshops, regional meetings and support for the development of learning tools with tracking and diagnostic purposes.

The Carrefour has identified a certain number of axes of improvement and entrusted **Performa** with the preparation of learning kits showcasing activities on each of these axes. Contrary to previously published learning kits, this consists of a single document that includes both the animation guide and the complementary texts.

A good number of the theoretical texts found in this learning kit were penned by Ulric Aylwin or refer to his writings: this is the deliberate intention of the originator of the kit, Mr. Guy Archambault and the management of the **Carrefour** who wanted to honour the memory of this pioneer of collegial education.

Learning kit 6 *New Educational Strategies* was developed by Mr. Guy Archambault under the terms of an agreement between *Le Carrefour de la réussite au collégial* and Performa. The texts contained herein may be reproduced inasmuch as mention is made of their source**.**

To avoid weighing down the text and for ease of reading, the masculine gender is used throughout this learning kit.

Contents

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General presentation

Your whole past was but a birth and a becoming up to the present day.

The one thing that matters is the effort.

Antoine de Saint-Exupéry, *Wisdom of the sands*

I. Objectives of the learning kit on New Educational Strategies (NES)

Two primary objectives inspired the creation of this learning kit. It was developed first and foremost to provide learning tools for those in charge of student success at collegial level; and secondly, to enable this group to sensitize professors to the new educational strategies (NES). It is not a training tool because the acquisition of any new educational strategy requires more than a few lunchtime hours or one pedagogical day. But, in addition to sensitizing professors to NES, the learning kit also encourages them to implement professional practices based on educational strategies that support in-depth learning.

II. Contents of the learning kit

1. Activities

Section one of the kit contains fifteen learning activities. This section makes it easy to judge at a glance which activities could be adapted for the sensitization of professors to NES. Each activity is described in one page. The scope and purpose of each activity is briefly outlined: title, duration, short description, objectives, role of participants, role of moderator, required material, unfolding, number of participants, comments.

The material presented in this learning kit is complete in itself, but careful preparation on the part of the moderator is a must, especially if he is inexperienced in terms of content and process. So although the material is complete, it requires input from the moderator.

Each activity is rated on a scale of *most difficult* (No 1) to *least difficult* (No 15) according to:
a- The complexity of implementation; **b-** The skills and dexterity required to moderate.

The first eleven activities bring into play the action principles seen in: *The historical, practical and theoretical foundations of NES — new educational strategies have been around for one hundred years*, foreword to the texts in Section 3. Although many sensitization activities emphasize the role of perception in learning (one is the *formative evaluation*, the other, the *zone of proximal development*), the majority of new educational strategies described in this learning kit involve:

1. Problem solving and teamwork (PBL, *Case study*, *Cooperative learning*);
2. Playacting (*Simulation*, *Role play*);
3. Project (*Investigation, Project case method*).

Three activities (Nos 1, 4 and 8) are variations of activities seen in the learning kit on motivation. Here however, the objectives are different.

Activity 1	Limitations of the traditional educational strategy
Activity 2	My teaching style
Activity 3	Learning style of my students
Activity 4	The role of collective goal-setting in a *cooperative approach*
Activity 5	Case study and problem solving
Activity 6	Mediation and the zone of proximal development
Activity 7	Teamwork and decision-making
Activity 8	***The project***
Activity 9	The distribution of roles in teamwork
Activity 10	Individual work, teamwork and formative evaluation
Activity 11	Emotion, interaction, perception and learning
Activity 12	Panel
Activity 13	Debate
Activity 14	Teaching journal
Activity 15	Conference

2. Learning Tools

Twelve learning tools make up **section two**. The learning tools support the first twelve activities (more complex than the last three) and provide the guidelines for the precise and thorough unfolding of the activity. The learning tools are classified in accordance with the activities in **section one**. They include the material required for the activity.

Limitations of the traditional educational strategy

Learning tool 2	My teaching style
Learning tool 3	Learning style of my students
Learning tool 4	The role of collective goal setting in a *cooperative approach*
Learning tool 5	Case study and problem solving
Learning tool 6	Mediation and the zone of proximal development
Learning tool 7	Teamwork and decision-making
Learning tool 8	***The project***
Learning tool 9	The division of roles in teamwork
Learning tool 10	Individual work, teamwork and formative evaluation
Learning tool 11	Emotion, interaction, perception and learning
Learning tool 12	Panel

3. Texts

The third section includes fifteen texts that provide greater explanations on the new educational strategies. These fifteen texts were chosen because they meet the following criteria:

- they support the activities;
- they provide a clear understanding of a new educational strategy;
- they describe the theoretical and practical foundations of the NES.

In the foreword to *Historical, practical and theoretical foundations of NES – new educational strategies have been around for one hundred years,* the author of this learning kit describes the practical and theoretical foundations of NES: a brief recall of their origin and the eight instructional action principles that inspire the strategies.

Foreword
Archambault, G. *Historical, practical and theoretical foundations of NES – New educational strategies have been around for one hundred years*

Text 1
Aylwin, U. "Differentiated instruction makes its entry in colleges", translated from Pédagogie *collégiale*, vol. 5, No 3, p. 30-37, March 1992.

Text 2
Aylwin, U. "The principles of a good educational strategy", translated from *Pédagogie collégiale*, vol. 5, No 4, p. 11-15, May 1992 and vol. 6, No 1, p. 23-29, September 1992.

Text 3
Aylwin, U. "Teamwork: why and how?", translated from *Pédagogie collégiale*, vol. 7, No 3, p. 28-32, March 1994.
The text of Ulric Aylwin is followed by an outline of the contents of two volumes:
1) **Johnson**, **D.W.**, **Johnson**, **R.T.**, **Holubec**, **E. J.,** *Cooperative learning in the class*, ASCD, Alexandria, Virginia, 1994.
2) **Abrami**, **P.C.**, **Chambers**, **B.**, **Poulsen**, **C**, **De Simone**, **C.,** **Apollonia**, **S.** and **Howden, J:** *The cooperative learning theories, methods, activities*, translation of Classroom *Connections*, Editions Chenelière Inc, 1996.

Text 4

Van Stappen, Y. "The Case Method", translated from *Pédagogie collégiale*, vol. 3, No 2, p. 16-18, May 1989.
The text of Yolande Van Stappen is followed by an outline of the table of contents for: **Wasserman, S.,** Introduction *to Case Method Teaching A Guide to the Galaxy*, Teachers Press College, New York, 1994.

Text 5

Poirier Proulx, L. "Teaching and learning problem solving", translated from *Pédagogie collégiale*, vol. 11, No 1, p. 18-22, October 1997.

Text 6

Legault, B. "Problem solving in electrical engineering", translated from *Pédagogie collégiale*, vol. 13, No 4, p. 42-45, May 2000.
The text of Bernard Legault is followed by an outline of: **Busque, L.** *Cinq stratégies gagnantes pour l'enseignement des sciences et de la technologie*, Chenelière/McGraw-Hill, Montréal, 1998.

Text 7

Laurin, S. "Learning through collective projects, or when students take control… », translated from *Pédagogie collégiale*, vol. 4, No 2, p. 20-22, December 1990.

Text 7 is followed by an outline of a work by Lucie Arpin and Louise Capra, 2001, in *L'apprentissage par projets : fondements, démarche et médiation pédagogique du maître dans la construction des savoirs de l'élève*, Montréal, Chenelière/McGraw-Hill, member of Chenelière Éducation. 270 p.

Text 8

Belleau, J. "An alternate teaching approach at collegial level: The Freinet approach", translated from *Pédagogie collégiale*, vol. 13, No 1, p. 27-33, October 1999.

Text 9

Matteau, P. "Mastery Learning: an integrating strategy", translated from *Pédagogie collégiale*, vol. 2, No 1, p. 14-17, October 1988.

Text 10

Howe, R. "Teaching formulas and formative evaluation: a winning combination", translated from *Pédagogie collégiale*, vol. 4, No 4, p. 8-13, May 1991.

Text 11
Aylwin, U. "In defence of formative evaluation", translated from *Pédagogie collégiale*, vol. 8, No 3, p. 24-32, March 1995.

Text 12
Aylwin, U. "Educational changes are long overdue" translated from *Pédagogie collégiale*, vol. 9, No 4, p. 16-20, May 1996.

Text 13
Aylwin, U. "Beliefs which prevent professors from progressing", translated from *Pédagogie collégiale*, vol. 11, No 1, p. 25-31, October 1997.

Text 14
Tardif, J. "The construction of knowledge, 2 .Teaching practices", translated from *Pédagogie collégiale*, vol. 11, No 3, p. 4-9, March 1998.

Text 15
Brundage, D. *"Adult Learning principles in support of learning activities" adapted from Adult Learning Principles and their Application to Program Planning, Ontario department of education, 1980, p. 21 to 57.*

III Additional Resources

We asked: "Which NES are currently being implemented in colleges?" The limited response had us initially believing that there were "almost none". However, we know that a number of cégeps are currently experimenting with various NES, and documents produced within PAREA over the last 12 years strongly support this assertion.

Together with the texts in **section three**, the following can also help familiarize the reader with NES:

Archambault, G. *47 façons pratiques de conjuguer enseigner avec apprendre. Les pratiques spécifiques à la profession enseignante,* Les Presses de l'Université Laval, 2nd edition, Sainte -Foy, 2000.

Archambault, G. and **R. Aubé**	*Questionnaire sur les pratiques professionnelles enseignantes, I Cadre théorique, II Guide d'utilisation, III Guide d'interprétation des résultats.* Regroupement des collèges PERFORMA, Collège Shawinigan, Shawinigan, 2000.
Lasnier, F.	*Réussir la formation par compétences*, Guerin, Montréal, 2000.
Soukini, M. and **J Fortier**	*L'apprentissage par problèmes, Collège de Sherbrooke, PAREA, Sherbrooke, 1995.*
St-Jean, M.	*L'apprentissage par problèmes dans l'enseignement supérieur, Service d'aide à l'enseignement, Université de Montréal, Montréal, 1994.*
Tozzi, M.	*Penser par soi -même :initiation à la philosophie*, Lyon: Chronique sociale de France; Bruxelles : Vie ouvrière,, 1994.
Wasserman, S.	*Introduction to Case Method Teaching A Guide to the Galaxy*, Teachers Press College, New York, 1994.

Another recommended read is *Répertoire de l'animateur de groupe*, by **W. Pfeiffer** and **J.E. Jones,** published by Actualisation in Montreal. Six initial volumes were published in 1982 and six more followed in 1992. They contain over 500 learning activities organized under 6 headings and involving over 30 topics:

1. Personal development (sensory development, feelings, perceptions, life orientation, etc.);
2. Interpersonal development (verbal and non-verbal communication, confidence, listening, etc.);
3. Group phenomena (participation, leadership, perceptions, problem solving, etc.);
4. Teamwork (competition, collaboration, conflict resolution, consensus, etc.);
5. Organizations (organizational diagnosis, decision, planning, conflict resolution, etc.);
6. Instruction (getting to know and creating teams, resistance to change, performance evaluations, closing activities, etc.).

In closing, we would like to recommend four Internet sites of particular interest.

The first site requires knowledge of French, and is by Jean-Yves Morin. It provides a clear picture on the application of Mastery Learning:

http://cours.collegeshawinigan.qc.ca/~jymorin/index.htlm

(Jean-Yves Morin received the Minister's Award for his teaching document: *Économie globale: manuel pratique*, published by Modulo in Town of Mount-Royal, 1995. This document is also a good illustration of Mastery Learning.)

The second site (quantum leap) also requires knowledge of French, belongs to the Centre d'actualisation for science professors at collegial level and has a wealth of information on NES for natural sciences:

http ://www .apsq .org /sautquantique /concours .htlm

The third site offers a series of examples of NES adapted to the field of natural sciences:

http ://ublib.buffalo .edu /libraries /projects /cases /ubcase .htlm

Fourth site is the DISCAS toolbox:

http ://discas.ca/

Section I
Learning activities

Activities designed to increase awareness
of new educational strategies
and their impact on
learning and student success

Five guiding principles for learning activities that increase awareness of new educational strategies **and their impact on learning and student success**

For more detailed explanations on the principles which direct the learning activities, refer to text *15 Adult Learning principles and their application to Program Planning*.

<table>
<tr><th>Postulates</th><th>Principles</th></tr>
<tr><td rowspan="4">▪ The individuals participating in the sensitization activities have multifactorial characteristics (age, experience, discipline, educational background, etc.).
▪ The participants in the sensitization activities offer multi-faceted motivation.
▪ The number of participants translates into a multidiversified range of perceptions, expectations, relationships and interactions.
▪ Anything can occur in the interaction of the moment.</td><td>1. The moderator cannot use a rigid approach or plan precisely how the activities will unfold.</td></tr>
<tr><td>2. He must lead the group as if it were a jam session or an improvisation.</td></tr>
<tr><td>3. The guidelines dictate the theme and objectives of the activity.</td></tr>
<tr><td>4. The interaction among participants calls for situational teaching.</td></tr>
<tr><td colspan="2">5. The activities and learning tools are frameworks to be adjusted by the moderator according to his personality, the reality of his environment and his targeted objectives. In addition, the moderator must adapt his action to what is occurring in the moment.</td></tr>
</table>

Activity 1

(2 to 3 hours)

This activity is a variation of activity No 2 in the learning kit on motivation.

Heading	**Limitations of the traditional educational strategy**
Description	In teams of three or four, participants reproduce a theoretical presentation with procedural contents to assess its effectiveness.
Objective	**1-** To become familiar with a new educational strategy: *Simulation*. **2-** To identify the limitations of the traditional approach (lecture) and the changes needed to support learning.
Role of participants	Initially, each individual assumes one of three successive roles: professor, student and observer. After reflecting on his experience in the role-play activities, the individual identifies conditions necessary for a lecture to support in-depth learning.
Role of moderator	To moderate the various stages of the activity. To assist in identifying conditions in which a lecture can support in-depth learning. To describe the basic elements of a *Simulation*.
Material required	**A –** *Learning Tool 1*. **B-** *Theoretical Texts: foreword, 1, 9, 10 and 15*.
Unfolding	**1-** Division of the group into teams of three people, - four if need be, when it is impossible to do otherwise (5 minutes). **2-** Simulation, following the instructions of *Learning Tool 1 (*60 minutes). **3-** Review what has been experienced - identify practices which allow a lecture to support in-depth learning, in particular formative evaluations (45 minutes). **4-** Short presentation on *Simulation* (cf. Section II, p. 108) and on the general principles which differentiate the traditional approach from NES (15 to 20 minutes).
Participants	Minimum: two or three teams of three people. Maximum: six or seven teams of three people
Comments	This experiment is sometimes a rude awakening for participants as they come to terms with what students in the classroom experience during a theoretical presentation. Conversely, it makes it possible to discover simple practices that can be adopted to make the presentation more interesting and effective. With the help of the foreword to the fifteen texts, this activity can help clarify the differences between a traditional approach and new educational strategies.

Activity 2

(30 to 45 minutes)

Heading	**My teaching style**
Description	Each participant identifies his own style of teaching.
Objectives	**1-** To become familiar with the new educational strategy: *Investigation*. **2-** To take stock of one's current teaching style. **3-** To identify which new educational strategies are compatible with this style.
Role of participants	To complete the questionnaire. To compile the results. To discuss the results obtained in relation to targeted goals.
Role of moderator	To explain the procedure for filling in the questionnaire and to compile the results. To provide information for interpreting the results. When the activity is done within a departmental framework or program team, to facilitate the exchange between participants and help provide an overview of the different styles used.
Material required	*Learning Tool 2*.
Unfolding	**1-** Sensitization to the goals of this activity (5 minutes). **2-** Administration of the questionnaire and compilation of the results (10 minutes). **3-** Interpretation and discussion of the results (10 to 15 minutes for an individual, 30 to 40 minutes for a group). **4-** Classroom application: identify advantages and opportunities for using *Investigation* (cf. Section II, p. 109) in the classroom and identification of the conditions that make it effective with cégep students.
Participants	Minimum: no minimum. Maximum: department members or a team of professors in the same program.
Comments	Each participant has an opportunity to reflect on the impact his teaching style has on the integration of learning by his students. Each participant can also relate the activity to a meaningful whole and take stock of his own professional practices. This activity, when combined with the next one, makes it possible to see to what extent the participant's teaching style corresponds to the dominant learning styles of the students in his classroom.

Activity 3
(2 to 3 hours)

Heading	**Learning style of my students**
Description	Each participant administers a questionnaire to his students, then compiles and interprets the results.
Objectives	**1-** To become familiar with the new educational strategy: *Investigation.* **2-** To identify dominant student learning styles. **3-** To verify the extent to which one's teaching style corresponds to the dominant learning styles of the students in the classroom.
Role of participants	To have the students complete the questionnaire. To compile the results. To discuss the results obtained according to the desired goals.
Role of moderator	To explain how to complete the questionnaire and to participate in the compilation and interpretation of results. If the activity is done within a departmental framework or program team, to facilitate exchanges between participants and thus provide an overview of the dominant learning styles of students in the program.
Material required	*Learning Tools 2 and 3.*
Unfolding	**1-** Explanation of the goals of this activity (5 minutes). **2-** Interpretation and discussion of the results following the compilation of the questionnaire results (10 to 15 minutes for an individual, 30 to 40 minutes for a group). **3-** Classroom application: identify advantages and opportunities for using *Investigation* (cf. Section II, p. 109) in the classroom and identification of the conditions that make it effective with cégep students.
Participants	Minimum: no minimum. Maximum: all the members of a department or a team of professors in the same program.
Comments	Activity No 2 is a prerequisite here. This new activity, following upon the previous one, makes it possible to see to what extent each participant's teaching style corresponds to the learning styles of the students in his classroom.

Activity 4

(75 to 90 minutes)

This activity is a variation of activity No 3 described in the learning kit on motivation.

Heading	**The role of collective goal-setting in a *Cooperative Approach***
Description	The participants get together to solve a problem.
Objectives	**1-** To become familiar with an educational strategy that combines teamwork and problem solving: *Cooperative Approach*. **2-** To discover the key role played by collective goal-setting in a *Cooperative Approach*. **3-** To visualize the four styles of learning as per Kolb and Fry.
Role of participants	To experience a problem situation, to identify its components, to work out a solution strategy and test it. To reflect back on the experience. To apply it in the classroom.
Role of moderator	To explain the goals. To facilitate the activity, initiate a review of the experiment and identify classroom applications. To conclude with a presentation on the *Cooperative Approach* and the four learning styles of Kolb and Fry (text 4 item 5 in the motivation kit).
Material required	**A-** *Learning Tool 4*: The role of collective goal-setting in a cooperative approach. **B-** *Theoretical Text 3*. **C-** Text 4 item 5 in the motivation kit.
Unfolding	**1-** Presentation of the goals (5 minutes). **2-** Experimentation begins; adherence to the instructions in *Learning Tool 4* (40 minutes). **3-** Review of the experiment and classroom applications (identification of advantages and opportunities for teamwork in the classroom as well as conditions that make it effective with cégep students) (30 minutes). **4-** Presentation of learning styles according to Kolb and Fry, using text 4 item 5 of the motivation kit (15 minutes). **5-** Presentation of key features of a *Cooperative Approach* using text *3* (15 minutes).
Participants	Minimum: six. Maximum: fifteen to twenty.
Comments	This activity has consistently allowed participants to live the team experience and to reach their learning objective through the resolution of a problem. It is not always easy to help participants distance themselves from the problem so as to transfer pedagogical applications to their own classroom teaching.

Activity 5

(75 to 90 minutes)

Heading	**Case study and problem solving**
Description	The participants examine a case study involving the analysis of data that makes it possible to solve a problem.
Objectives	**1**- To become familiar with the new educational strategy: *Case study* **2**- To recognize the importance of the first phase of the problem-solving process (namely *the definition of what the problem is versus the search for and application of solutions*).
Role of participants	Do a case study. To identify the questions that must be asked to determine problem specificity.
Role of moderator	To clearly explain the objectives and the procedures to follow at each step. To divide the group into teams. To end with a brief presentation on the key steps of problem solving and *Case study*. Moderate the exchanges which ensue.
Material required	**A** –*Learning Tool 5*. **B** T*heoretical Texts 4 and 6.*
Unfolding	**1-** Presentation of the objectives and the procedures to follow (3 minutes). **2-** Division into teams of five to seven people (2 minutes). **3-** Identify key questions to help determine the specificity of the problem (20 minutes). **4-** Compare the best three (team) questions and validate their effectiveness in identifying problem specificity (20 minutes). **5-** Presentation of problem solving processes and the *Case study (*cf. Section II, p. 110-111) (20 minutes). **6-** Discussion: identify classroom applications, advantages and opportunities for *Case study* and *Problem Solving* in the classroom and conditions to make them effective with cégep students (25 minutes).
Participants	Minimum: a team of five to seven people. Maximum: four or five teams of five to seven people.
Comments	Certain participants may experience great difficulty in dealing with the problem due to their spontaneous attitude that consists of going through the problem definition phase quickly and imagining immediate solutions.

Activity 6

(60 to 70 minutes)

Heading	Mediation and the zone of proximal development
Description	The participants must work together to find the algorithm of a problem.
Objective	To carry out an experiment on *mediation* and the *zone of proximal development* within the framework of a *Cooperative Approach*.
Role of participants	To assist one another in finding and mastering the algorithm of the problem so that the participant who is the least skilled at the start of the activity can succeed just as well as the most skilled participant.
Role of moderator	To guide the participants through the steps of *Learning Tool 6*. To facilitate a review of the activity through a synthesis of discoveries on the learning process used in peer mediation, within the *Cooperative Approach*.
Material required	**A –** *Learning Tool 6*. **B-** *Foreword to the 15 texts*.
Unfolding	**1-** Presentation of the objectives and procedure to follow (2 minutes). **2-** Demonstration of expected results (6 minutes). **3-** Setting up teams of 6 to 9 people (2 minutes). **4-** Teamwork (20 to 25 minutes). **5-** Review of what has been experienced and its relevance to the classroom; identifying team behaviour that allows the more skilled student to mediate with the slower or less skilled student (25 minutes). **6-** Presentation (5 to 10 minutes).
Participants	Minimum: one team of six to nine people. Maximum: three to four teams of five to eight people.
Comments	At the initial stage of this problem solving activity, some participants are quicker and more skilled at identifying and mastering the algorithm than others. It is important to allow participants to experience the zone of proximal development and to allow for the emergence of spontaneous mediation behaviour.

Activity 7
(75 to 90 minutes)

Heading	**Teamwork and decision-making**
Description	Each team must reach a consensus on a series of proposals submitted to them.
Objectives	**1-** To conduct an experiment on the importance of reaching a consensus in the *Cooperative Approach*. **2-** To identify how the principles of adult learning are applicable to young college students. **3-** To introduce Problem-based learning (PBL).
Role of participants	To reach a consensus on a series of proposals.
Role of moderator	To guide the participants through the stages of *Learning Tool 7*. To facilitate a review of the activity whereby students synthesize their discoveries relative to the learning process of young adults. To examine with the participants, the role of the consensus in a *Cooperative Approach*
Material required	**A-** Learning *Tool 7*. **B-** *Theoretical Texts 3 and 15*.
Unfolding	**1-** Presentation of the objectives and the procedure to follow (5 minutes). **2-** Individual work (10 minutes). **3-** Teamwork (45 minutes). **4-** Review of what has been experienced. **5-** Discussion: identify classroom applications, advantages and opportunities for using teamwork in the classroom as well as conditions that make it effective with cégep students (25 minutes). **6** To introduce *Problem-based learning* (cf. Section II, p. 112)
Participants	Minimum: one team of five to eight people. Maximum: three to four teams of five to eight people.
Comments	1- In this intellectual activity, it is important to clearly define the meaning of consensus and to insist on a consensus for all the answers given by the team. 2- According to **C. Danis** and **N.A. Tremblay,** significant research has been done to prove the effectiveness of the 17 principles seen in *Learning Tool 7* "Principes d'apprentissage des adultes et autodidaxie» (Principles of adult learning and self-culture), *Revue des Sciences de l'éducation*, vol. XI, No 3, 1985

Activity 8

This activity is a variation of activity No 5 in the learning kit on motivation.

Heading	The project
Description	Volunteer professors study and identify teaching practices that support in-depth integration of learning among their students. Then they present the results of their research to colleagues at a mini symposium.
Objectives	**1-** To sensitize the academic environment to the importance of student participation in the classroom for successful learning. **2-** To identify educational practices considered effective by cégep students. **3-** To become familiar with the educational strategy: *Project*
Role of participants	The professors lead the study; they administer the questionnaire, enter the data on a computer, interpret the results and present them to their colleagues.
Role of moderator	To support professors throughout the activity. To organize a mini-symposium to present the research findings. To publish the results in the local teaching journal. To present the *Project* as an educational strategy. To help professors create the conditions needed to apply the strategy in their classrooms.
Material required	**A-** *Learning Tool 8.* **B-** *Theoretical Text 7.*
Unfolding	At the discretion of the professors who initiate and carry out the project. Schedule a final meeting to help professors identify the conditions needed to apply the *Project* educational strategy in class (cf. Section II, p. 113)
Participants	Minimum: 3 to 5 college professors from two separate disciplines and approximately 150 students in the fourth session of their program. Maximum: 6 to 8 professors from three separate disciplines and approximately 450 students in their fourth session.
Comments	Should the person responsible for student success at collegiate level use this activity to sensitize their environment to the importance of student participation in the learning process, the author of this learning kit would be very pleased to receive feedback.

Activity 9
(50 to 60 minutes)

Heading	The division of roles in teamwork
Description	Participants reach a consensus on the definition of roles within a team working on a *Collective Project*.
Objectives	**1-** To sensitize the participants to the importance of allocating roles to the students in the *Collective Project* and *Cooperative Approach*. **2-** To become familiar with the educational strategy: *Cooperative Approach or the Project*
Role of participants	Participants work towards a consensus on fifteen sentences defining the roles in teamwork.
Role of moderator	To explain the objectives and the procedure to follow. To divide into teams if there are more than 12 participants. To collect the answers obtained by consensus. Provide the corrected answers. Present the *Cooperative Approach*. Moderate the discussion that may ensue.
Material required	**A -** *Learning Tool 9*. **B-** Theoretical *Texts 3 and 7.*
Unfolding	**1-** Presentation of the objectives and the procedure to follow (5 minutes). **2-** Individual work (10 minutes). **3-** Teamwork (45 minutes). **4-** Review of what has been experienced. **5-** Discussion: classroom application by identifying advantages and opportunities for using teamwork in the classroom as well as the conditions that make it effective with cégep students (25 minutes).
Participants	Minimum: six to 12 participants. Maximum: about thirty.
Comments	The consensus requested from the teams implies that all agree with the answers given to each of the fifteen sentences. It is not a question of working towards a consensus, but of reaching one. A majority or a "*unanimous vote minus one*" is not acceptable. Consensus is seldom reached spontaneously; it is reached through exchanges and discussion. The consensus as an educational strategy aims to develop coherence and cohesion within the team. In *real life*, consensus is reserved for scenarios where the existence or survival of a group is at stake.

Activity 10

(60 to 75 minutes)

Heading	**Individual work, teamwork and formative evaluation**
Description	Each individual provides answers to eleven questions. Then teams try to find the correct answers.
Objectives	**1-** To compare the results of individual versus teamwork. **2-** To become familiar with formative evaluation practices that could be easily adapted to the classroom for more effective monitoring of student progress in class.
Role of participants	To provide answers for eleven questions, individually. Then using these answers, to discuss with the team and reach a consensus on final answers. Finally, to compare the number of correct individual answers to the number of correct team answers. To elaborate on the results of this comparison.
Role of moderator	To explain the objectives and the procedures to follow. To provide and discuss the correct answers. To facilitate a review on the experience. To describe formative evaluation practices that can be easily adapted to the classroom for more effective monitoring of student progress in class.
Material required	**A-** *Learning Tool 10*. **B-** *Theoretical Texts 9*, *10* and *11*.
Unfolding	**1-** Explanation of the goals of the activity (5 minutes). **2-** Individual answers (5 minutes). **3-** Setting up of teams of 6 to 8 people (5 minutes). **4-** Answers reached by consensus, beginning with individual answers (15 to 20 minutes). **5-** Presentation of corrected answers and comparison of individual answers to team answers (5 minutes). **6-** Review of what has been experienced and a presentation on formative evaluation practices (25 to 30 minutes).
Participants	Minimum: six people. Maximum: four or five teams of six to eight people.
Comments	The required team consensus implies that all agree with each answer given. A majority or a *"unanimous vote minus one"* is not acceptable. Working towards a consensus is an essential educational strategy for the success of this activity. Each individual must be able to explain and defend the answers given by the team.

Activity 11

(50 to 60 minutes)

Heading	**Emotion, interaction, perception and learning**
Description	Two experiments, followed by a discussion, illustrate the role of emotions, interaction and perception in learning.
Objectives	**1-** To determine if learning is more effective when emotions are kept at bay and when there is no interaction between students. **2-** To explore the importance of perception in the learning process.
Role of participants	To rate words. To discuss the causes of long-term memorization.
Role of moderator	To coach participants step by step in the completion of the two experiments using *Learning Tool 11*. To moderate discussions. To make a short presentation on the role of perception in learning using *Theoretical Text 1*.
Material required	**A -** *Learning Tool 11*. **B-** *Theoretical Text 1*.
Unfolding	**1-** Short Presentation of goals (5 minutes). **2-** Unfolding of the two experiments (25 minutes). **3-** Review of the experiments (15 minutes). **4-** Presentation (10 minutes).
Participants	Minimum: ten to twelve. Maximum: about thirty.
Comments	For the presentation, the moderator can refer to pages 7 to 17 of the book by Guy Archambault, *47 façons pratiques de conjuguer enseigner avec apprendre*, 2nd edition, Les Presses de l'Université Laval, Sainte-Foy, 2001.

Activity 12

(45 to 60 minutes)

Heading	Panel
Description	After the publication and compilation of an opinion poll, professors are invited to participate in a debate where four will argue in favour of NES and comment on the results of the opinion poll. An audience question and answer period will follow.
Objective	To explore the advantages, conditions and personal effort required to adopt new educational strategies in the classroom.
Role of participants	To listen. To ask questions. To comment on the opinions of the four panellists.
Role of moderator	To distribute the opinion poll, then collect and compile the data. To present the debate objectives and the initial results of the questionnaire. To introduce the four panellists. Allow the participants to voice their opinions.
Material required	**A-** *Learning Tool 12.* **B-** *Theoretical Texts 12*, *13* and *14.*
Unfolding	**1** Distribution of the opinion poll. **2-** Collection and processing of data and announcing of panel formation. **3-** Panel organization. **4-** Management and moderation of the panel.
Participants	Minimum: ten to twelve professors and students. Maximum: no limit.
Comments	The panellists can use the *texts* in the learning kit to prepare their arguments. Moderating a panel discussion can be a delicate operation: people sometimes have difficulty separating a person from his ideas. The choice of the four panellists is crucial; it is essential that they use descriptive, not provocative language, that they be good at repartee, have a sense of humour and be comfortable expressing themselves in public.

Activity 13

(45 to 60 minutes)

Heading	**Debate**
Description	One professor takes the pro side of formative evaluation and another takes the opposite side. Both answer questions from the audience.
Objective	To explore the advantages of systematic use of formative evaluations for the student; the conditions needed for effective evaluations.
Role of participants	To listen. To ask questions. To comment on the opinions of the two debaters.
Role of moderator	To present the debate objectives. To introduce the two debaters. To encourage audience participation.
Material required	*Theoretical Texts 10 and 11.*
Unfolding	**1-** Publication of *Text 11* in the local teaching journal and announcement of the debate. **2-** Organization of the debate. **3-** Management and moderation of the debate.
Participants	Minimum: ten to twelve professors and students. Maximum: no limit.
Comments	The protagonists can use the *texts* contained in this learning kit to prepare their arguments. Moderating a debate is a delicate operation: people sometimes have difficulty separating the person from his ideas. The choice of the two debaters is crucial. They must be good at repartee, have a sense of humour and be comfortable with expressing themselves in public. If there is a healthy atmosphere at the college, a debate can be held between adepts of the traditional approach and those in favour of NES.

Activity 14

Heading	**Teaching journal**
Description	The publication of a series of articles on NES in a teaching journal.
Objective	To sensitize the members of the teaching staff to the importance of NES in supporting student success.
Role of participants	To read the articles and provide feedback.
Role of moderator	To submit articles, documents and questionnaires on what motivates learning to the teaching journal. To invite readers to respond.
Material required	All or part of the following materials can be used insofar as their source is mentioned: *texts 1, 2, 3, 4, 5, 6, 7 and 8*. Results of surveys, investigations or local research and its interpretation can also be published (see activities 8 and 12). It is also possible to publish, in part or in whole, the foreword to the 15 *texts*.

Activity 15

(45 to 60 minutes)

Heading	**Conference**
Description	A specialist in NES leads a conference on the topic and answers questions from the audience.
Objective	To sensitize the members of the teaching staff to the importance of NES in student success.
Role of participants	To listen. To ask questions of the lecturer.
Role of moderator	To organize the conference and announce it. To introduce the objectives and the lecturer. To moderate the question period that follows the conference. To thank the lecturer.
Material required	Based on the needs of the lecturer.
Unfolding	**1-** Presentations by the moderator (5 minutes). **2-** Conference (25 minutes). **3-** Question period (25 minutes). **4-** Acknowledgements (5 minutes).

Section II

Support tools for learning activities that sensitize the academic environment to new educational strategies

Learning Tool 1

Limitations of the traditional teaching strategy

Stage 1 *Explanation of objectives, procedures and unfolding of the activity.*

The moderator presents: **A.** the objectives of the activity; **B.** the unfolding of the activity and the rules to follow to optimize the realization of pedagogical objectives.

A. Objectives

The principal objective is to identify the power of speech in the classroom and its limitations in the integration of learning. The pursuit of this operational objective makes it possible to also achieve the five following goals:

- To explore what is experienced by students, professors and observers during communication between students and professors;
- To understand what goes on in the minds of students in class;
- To identify the limitations of the traditional approach relative to student learning in the classroom;
- To identify minor adaptations needed to facilitate in-depth learning;
- To identify the conditions under which a theoretical presentation will support in-depth learning;

B. Unfolding and rules of simulation

Since our initial task is to examine the power of speech in a lecture or presentation, it is necessary for the simulation and role-play to proceed in a context that will allow for observation to be focused on this single variable. The context chosen to isolate the variable (the spoken word) is a radio communication. The simulation will recreate as accurately as possible, an event that occurred in 1935: Someone used a radio transmitter located in Montreal to send an important message to an Inuit radio receiver located in the heart of Ungava.

The simulation proceeds in teams of three and includes three identical phases. In each phase, a member of the trio plays the role of the sender, another, the receiver, and the third observes the sender's communication and its impact on the receiver.

With each new phase, the roles are changed so that the individual will have played all three by the end of the activity: sender, receiver and observer.

The role of the sender is to transmit a description of a drawing as clearly as possible using a strategy he believes to be appropriate for both content and context. The role of the receiver is to transcribe the drawing on paper, based on what he hears. He plays the role of a person whose life depends on recreating the drawing. The observer notes the way in which the sender transmits the message; and then compares the transcription made by the receiver to the drawing held by the sender.

The spatial arrangement of the three people during each phase is important for the simulation. The sender should not see the receiver or what he is drawing, nor should he have access to nonverbal reactions. The receiver should not see the drawing that the sender has nor should he have access to the sender's nonverbal behaviour. Only the observer has access to the original drawing, the drawing made by the receiver and the nonverbal reactions of both sender and receiver.

Only the voice of the sender should be audible in the room during the simulations: all others are to remain silent. It would be ideal to recreate a type of polling station cubicle for each group: the sender and receiver sitting side by side separated by a cubicle wall, with the observer positioned in front of both, from where he can observe both. If there are several trios in the same room, they should be far enough apart to avoid verbal interferences such as loud voices, and to prevent receivers from seeing the drawing of another team.

Each of the three phases is a repetition of the simulation and consists of four periods: **A**, **B**, **C** and **D**. During period **A**, teams of three are set up and tables are arranged to recreate polling station cubicles. The individuals assume their roles. When all the teams are ready, the moderator gives a drawing to each person playing the role of sender. The sender has one minute to mentally prepare the message he wants to transmit. All others remain silent.

When this minute of silence is over, the moderator starts period **B** by advising each sender that he has seven minutes to give instructions to the Inuit receiver. The goal is simple: reproduce as closely as possible the drawing described by the sender.

At the end of seven minutes, period **C** begins. It consists of one minute of silence so that each individual may formulate an answer to a question asked by the moderator. Period **D** consists of comparing the original drawing to the transcription made by the receiver, reviewing what each participant experienced and including comments made by the observer.

Stage 2 *Setting up the Teams of Three.*

The moderator divides the group into teams of three. If the total number of participants is not a multiple of three, he creates as many teams of three as possible and completes these with teams of four, if necessary (for example, if there are 16 people, he creates four groups of three and one group of four; if there are 17 participants, three groups of three and two groups of four).

With groups of four, there are two observers during the first phase of the simulation. In the second phase, the sender and the receiver exchange places with the observers who then become sender and receiver.

During the third phase, each group of four divides to form two teams of two. There is no observer as each participant assumes the role of receiver or sender.

Several methods can be used to form groups of three, some simple and some more complex. A simple way is to allow participants to spontaneously create teams of three with two other people they hardly know or not at all.

Stage 3 *Phase 1 of the simulation and role play.*

A. Distribution of the drawings

The moderator prepares the material in advance, makes a sufficient number of photocopies of three of the four drawings (shown at the end of learning tool 1) glues them to cardboard and laminates them.

To facilitate observation of the desired variable i.e., the spoken word, the moderator ensures that all three roles are assumed and players are in their correct position. He also ensures that the positioning of the groups in the room does not in any way hinder the activity of other groups.

The moderator then gives each sender a laminated cardboard drawing. Each sender is given the same drawing so that results produced by the receivers can be compared (at the end of period **D** of each phase).

He then instructs the participants to observe one minute of silence to allow the sender to organize his thoughts. He mentions that each drawing is a series of simple geometrical forms laid out inside a rectangle that is 18 cm wide by 10 cm in height.

B. Role play

The moderator gives the starting signal for period **B** by reminding the sender that he has seven minutes and that if he finishes the description before the end of the period, he can summarize. He then circulates among participants, discreetly reminding them of the rules of the game when these are not respected (for example: the receiver reacts verbally, or the sender tries to see the nonverbal reactions of the listener).

C. Minute of silence

The moderator invites each participant to formulate an answer to this question: "*What is the central phenomenon, the dominating feeling I experienced during these last seven minutes*"

D. Spontaneous review in small teams

1. The moderator asks each team to look at the original drawing, the copy reproduced by the receiver and then to discuss the experience.
2. After six or seven minutes, he asks them to circulate around the room and look at the drawings reproduced by other teams.
3. He then asks them to take two minutes to collectively identify principles that could improve communication in the second simulation.
4. He collects the cardboards.
5. He asks team members to change roles and move to the corresponding position.

Stage 4 *Phase 2 of the simulation and role play.*

The moderator repeats the exact procedure described in points **A**, **B**, **C** and **D** of *phase 1* but uses a different drawing.

Stage 5 *Phase 3 of the simulation and role play.*

Before starting the procedure described in points **A**, **B**, **C** and **D** of *phase 1,* the moderator introduces a new variable. He tells participants that in the third phase the sender can ask the receiver *"Is everything okay?"* as many times as he wishes during the seven minutes. This is the only wording allowed. He may ask the question as often as he wants or not at all. When the sender asks the question, the receiver must respond. However, he may only reply with "yes" or "no".

When the new directive is understood by the participants, the moderator points out that except for this new variable, the third simulation is identical to the two preceding ones (except in the case of groups of four where they must now form two teams of two with no observer). The procedure then begins as described in points **A**, **B**, **C** and **D** of *phase 1,* using a third cardboard drawing that is different from the first two.

Step 6 *Group review of what was experienced in small teams*

A. Reflection and gathering of personal data on the experience

Each individual has five to six minutes to spontaneously answer the following questions, writing down whatever comes to mind:

- In which of the three roles did I feel most at ease?
- Are there similarities between what was experienced here and what occurs in the classroom?
- What basic principles should be respected to make a presentation interesting and effective?
- What basic principles should be respected for a presentation to favour in-depth learning?
- What can be done to make sure the presentation is understood as expected? Is this physiologically and psychologically possible?

B. Sharing experiences

- The moderator invites the participants to exchange views on the questions raised. He ends the exchange by summarizing the viewpoints expressed.
- He can introduce some principles for preparing an effective and stimulating presentation.
- He can present principal elements that distinguish new teaching approaches from the traditional approach.
- He can present the teaching strategy *Simulation* using the information sheet found in the appendix of this section.
- Finally, he can use this opportunity to stress the importance of formative evaluation, especially if participants are aware of the insufficiency of a "*yes*" or "*no*", as seen during the third phase of role play. He can then draw upon the many examples of formative evaluation practices in the *Theoretical Texts 10 and 11.*

Some principles for preparing an effective and stimulating presentation

1. No two people have the same perception, the same reality. It is impossible to reduce this variation to zero. Because of these differences and the impossibility of reaching perfect agreement on perception, it is important to reduce divergent views that impede team members from understanding each other. In the case of a presentation, we must try to ensure that what was heard is similar, if not identical, to what was transmitted (unless precise details are required as a matter of public health and safety).

The first step is to identify the part of the presentation that is essential or central and the portion that is complementary or secondary. This enables a quick assessment of how well a message was received in class: the professor can check student comprehension after a presentation or demonstration of 10-12 minutes (using a formative evaluation technique).

2. In order for learning to take root and for skills to be integrated into long-term memory, it is necessary to respect the *natural* laws of learning, laws recently discovered and confirmed by research in educational sciences. For instance, it is recognized that human attention cannot be centered continuously and intensely on the same subject for lengthy periods of time (the more complex the subject, the shorter the period of time) **without external support**. The brain is an organ similar to a bio-computer which captures and keeps imprints of the universes it encounters. It *remodels itself* and constantly reorganizes the impressions that bombard it, and does so more easily when these impressions originate from a variety of sensory sources.

3. To increase attention, natural *self-programming* and data reorganization when *new material* is presented to the brain, there should be no more than new 5 elements within a 15- to 25-minute period. To arouse interest, maintain attention and support in-depth learning, this new subject matter (or exercise) must:

- be presented as a whole, going from generalizations to specifics;
- be presented in a conventional and precise language, suitable for students;
- be presented so as to capture their imagination;
- be presented using examples, imagery, comparisons, metaphors;
- be positioned in relation to each other via connecting links;
- be restructured by the students themselves, in their own words;
- be used frequently by the student afterwards, and in a variety of ways;
- be connected by the student to his experience or current knowledge;

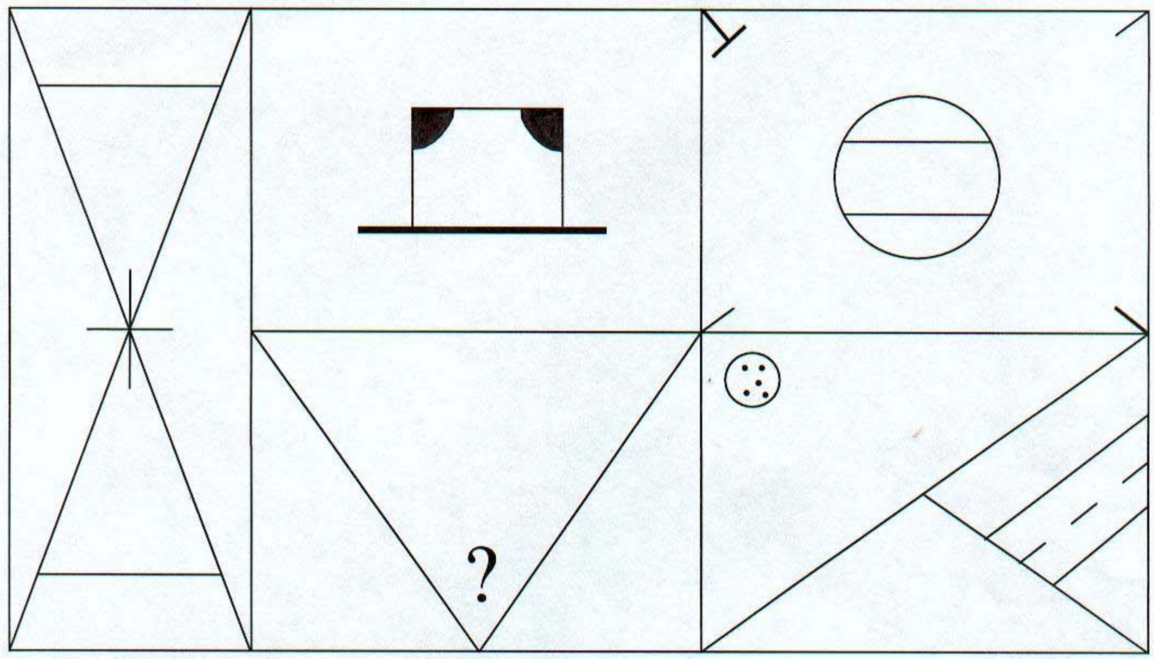
- be re-used in problem-solving activities;
- be used to carry out increasingly complex tasks;
- be used to carry out tasks in different contexts.

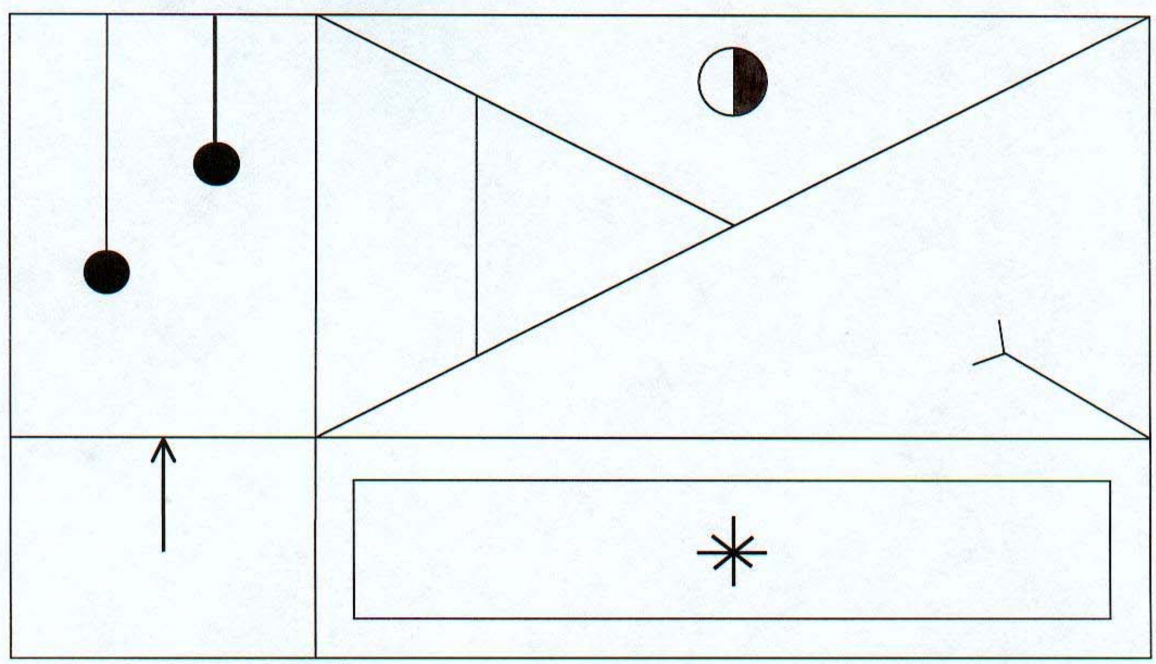
The following table compares six active educational strategies to the lecture approach, using twenty principles described by U. Aylwin, teaching principles based on scientific studies conducted on the brain and the human learning process (see *Theoretical Texts* 1 and 2).

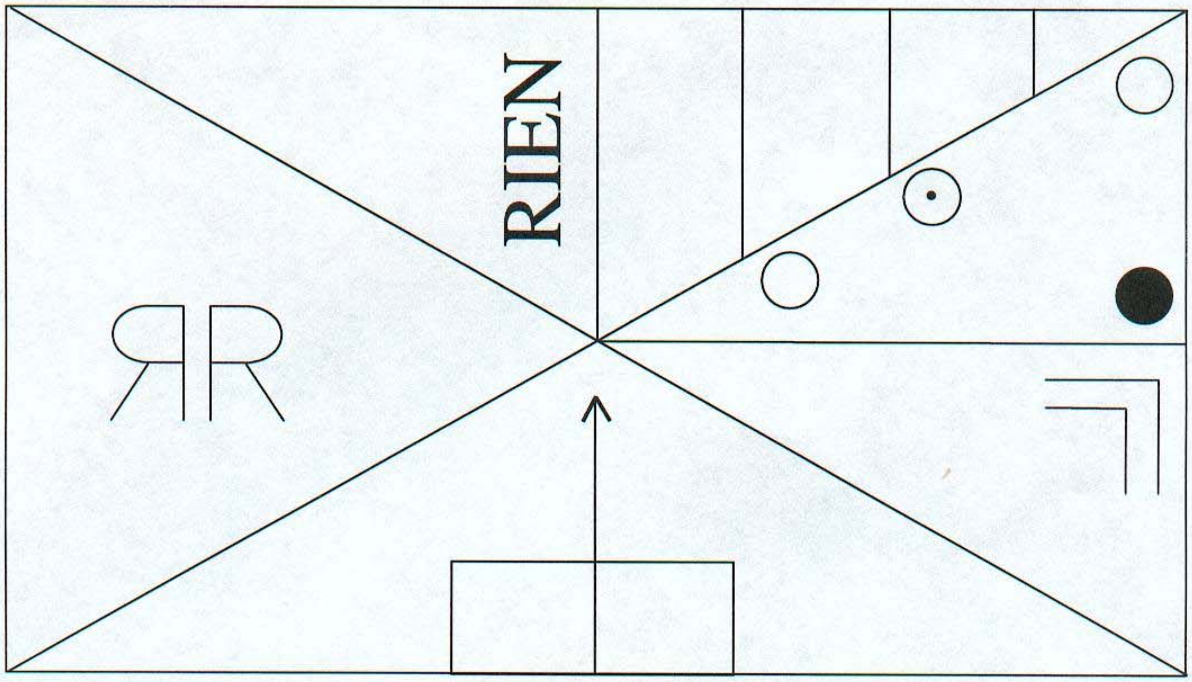
Comparative table

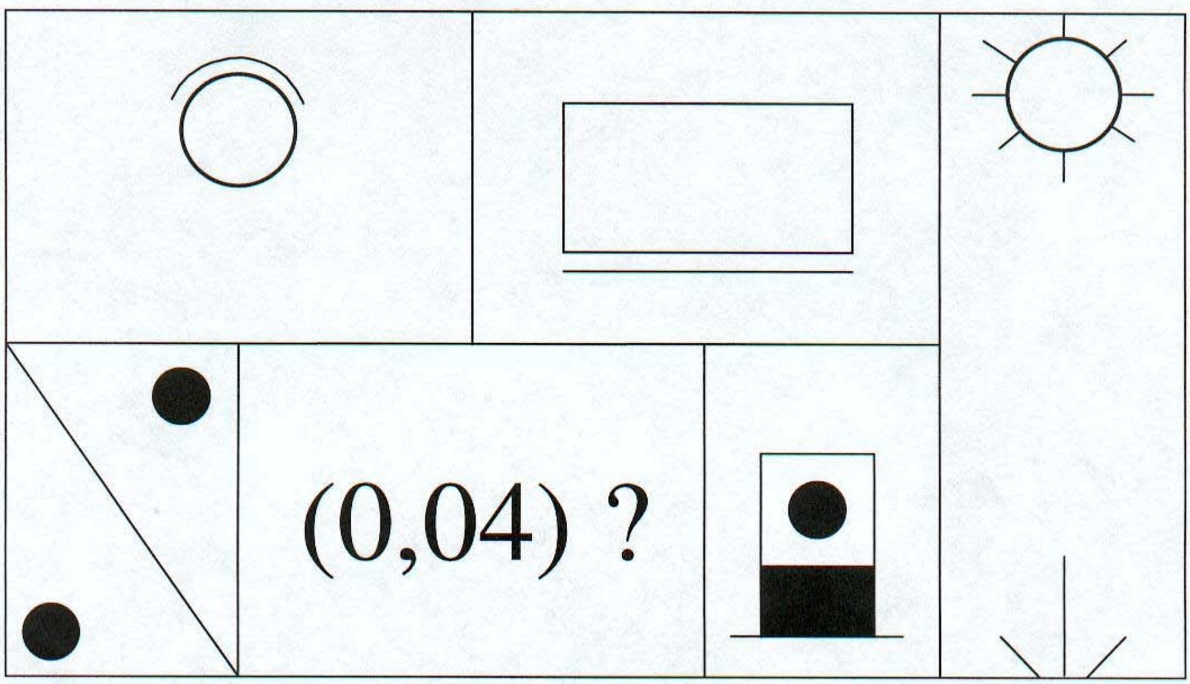
The lecture approach versus six new educational strategies relative to twenty principles governing the learning process

	Educational strategies						
Principles	Lecture	PBL	Prob.Solving wrkshp	Prog. teaching	Case study	Simul.	Project
1. The students prepare for each course		x	x	x	x	x	X
2. The professor's personal experience is called into play	x	x	X	x	x	x	X
3. Students receive answers to topical questions		x	X		x	x	X
4. The student's intrinsic motivation is called into play		x	X		x	x	X
5. The student's prior knowledge is called into play		x	X	x	x	x	X
6. We rely on central concepts	x	x		x			X
7. We frequently resort to formative evaluation		x	X	x	x	x	X
8. We frequently use self-evaluation tools		x	X	x	x	x	X
9. The student is more active than the professor in the classroom		x	X	x	x	x	X
10. We respect the scientific laws of learning		x	X	x	x	x	X
11. We use inter-teaching among students		x	X		x	x	X
12. The concrete regularly precedes the abstract		x	X		x	x	X
13. The transfer of learning is assured		x	X			x	X
14. The various learning styles are respected		x	X		x	x	X
15. We regularly call upon meta-cognition		x	X	x	x	x	X
16. What is learned is immediately useful or will be in the near future		x	X		x	x	X
17. We learn as much in the classroom as we do outside the classroom		x	X	x	x	x	X
18. Teamwork is frequently used		x	X		x	x	X
19. The laws governing brain function are respected		x	X	x	x	x	X
20. The goal is long-term retention		x	X		x	x	X









Rien= nothing

Learning Tool 2
My teaching style

What is your teaching style?

This questionnaire can help you identify the teaching style you use in the classroom. It can also help you identify which new educational strategies correspond to your teaching style; and the types of learning integration that your style supports. Eventually it will allow you to identify learning styles that are best suited to your teaching style.

The questionnaire is not for evaluation or diagnostic purposes but rather a tool to help you reflect on your professional teaching practices. The interpretation of results is based on a conception of the learning process identified by Jean Piaget. A description of five types of learning integration and the conceptual framework of teaching and learning used in the questionnaire are found in the second edition of *47 façons pratiques de conjuguer «enseigner» avec «apprendre»*, (**Guy Archambault**, PUL, 2001) and in *Les pratiques professionnelles enseignantes au niveau collégial*, (**Guy Archambault**, Cégep Beauce-Appalaches, Regroupement des collèges PERFORMA, Saint-Georges, 1999).

Procedure for completing the questionnaire

The task consists in allocating points to four options offered in each of the fourteen questions and repeating this same procedure for each of the fourteen questions.

1. Start by allocating **5** points to the option you most prefer among the four options listed, write the number **"5"**at the appropriate place.
2. Then score **0** points for the option you prefer the least, write the number **"0"**at the appropriate place.
3. Finally, score **3** points for the remaining option you prefer the most and **1** point for one you prefer the least; write the numbers "**3"** and "**1"** in the appropriate places.

Each of the fourteen situations begins with the following: ***I am an excellent professor when…***

1. … *my course plan is based on...*

A. ____ key concepts and general themes of the discipline or technique;
B. _____the official course or program guide;
C. _____the characteristics, needs and interests of my students;
D. _____methods that involve very active student participation.

2. … *the main learning objective in my courses is…*

A. _____good mastery of basic skills and knowledge;
B. _____ personal and professional independence;
C. _____ systematic interpretation and application of theories;
D. _____ significant disciplinarian or professional creativity.

3. … *my courses include …*

A. _____clearly defined tasks;
B. _____ the handling of concrete data or material by the students;
C. _____ the analysis and review of important questions;
D. _____ activities that stimulate student curiosity.

4. … *in describing my role to the students, I emphasize...*

A. _____ my teaching expertise;
B. _____ my technical or disciplinarian expertise;
C. _____ the fairness of my evaluation style;
D. _____ my availability to help them individually.

5. … *the classroom set-up…*

A. _____ lends itself to the creation of small work teams;
B. _____ includes the tools and material necessary for the activities;
C. _____ allows the students to adequately follow the professor;
D. _____ incorporates the appropriate audio-visual tools.

6. *... the working atmosphere in the classroom is focused on…*

A. _____ the study of actual problems;
B. _____ spontaneous expression;
C. _____ brilliant intelligence;
D. _____ tenacious application.

7. *… my students carry out...*

A. _____good projects;
B. _____ good syntheses;
C. _____ the work and reading expected of them after classes;
D. _____ work in teams.

8. *… my student's work focuses on...*

A. _____ summaries and reports;
B. _____ rigorous reasoning;
C. _____ imagination;
D. _____ personal expression.

9. *… my student assignments regularly include…*

A. _____ practical and progressive exercises;
B. _____ essays;
C. _____ on-site visits or internships;
D. _____ discussions among themselves.

10. *… I succeed in helping students develop …*

A. _____ an ability to view the whole picture;
B. _____ a quick-witted and inquisitive mind;
C. _____ an ingenious and creative mind;
D. _____ a methodical mind.

11. *… my students...*

A. _____ define a problem clearly;
B. _____ interact with me and the other students in the classroom;
C. _____ find and apply an original solution to a problem;

D. _____ are dedicated and hard-working.

12. … I am attentive...

A. _____to following my course plan in an ordered way, as established;
B. ____ to verifying if the students understood and what it is they understood;
C. _____ to the students' changing moods;
D. _____ to synchronizing my rhythm to the group's learning tempo.

13. … *to evaluate my students, I use...*

A. _____ tests with short and precise answers;
B. _____ problematical cases which require development;
C. _____ logbooks and portfolios;
D. _____ concrete projects dealing with everyday life.

14. … *my evaluation criteria take into account...*

A. _____ what is measurable, quantifiable and precise;
B. _____ the quality of the reasoning and the wording;
C. _____ the personal progress of each student;
D. _____ ingenuity, imagination and originality.

Compilation grid for answers to the questionnaire on teaching styles

1. For each of the fourteen questions, transcribe your scores (5, 3, 1 and 0) to the appropriate places.
2. Add up each column to discover your dominant style and your secondary style.

	No	- I -	- II –	- III –	- IV –
I. To create a teaching project					
1. To establish objectives based on the learning to achieve.	**1**	**C** ____	**A** ____	**B** ____	**D** ____
	2	**B** ____	**A** ____	**C** ____	**D** ____
2. To choose a teaching approach appropriate for achieving the learning objectives.	**3**	**D** ____	**C** ____	**A** ____	**B** ____
II. To facilitate a teaching project					
3. To clarify the purpose of the instruction for the students.	**4**	**D** ____	**B** ____	**C** ____	**A** ____
4. To create conditions necessary for motivation that is intrinsic to learning.	**5**	**A** ____	**D** ____	**C** ____	**B** ____
	6	**B** ____	**C** _____	**D** ____	**A** ____
5. To use a teaching approach that favours a progressive integration of learning.	**7**	**D** ____	**B** ____	**C** ____	**A** ____
	8	**D** ____	**A** ____	**B** ____	**C** ____
	9	**D** ____	**B** ____	**A** ____	**C** ____
6. To provide students with relevant feedback on their learning.	**10**	**B** ____	**A** ____	**D** ____	**C** ____
	11	**B** ____	**A** ____	**D** ____	**C** ____
7. To adapt my teaching to suit the variations in the pedagogical situation.	**12**	**C** ____	**A** ____	**B** ____	**D** ____
III. To evaluate a teaching project					
8. To evaluate the results of the intervention and the teaching approach used.	**13**	**C** ____	**B** ____	**A** ____	**D** _____
	14	**C** ____	**B** ____	**A** ____	**D** _____
Total					

An analysis of your teaching style

A professor can display each of the following four styles in varying degrees. The purpose of the questionnaire is to highlight your dominant style (highest score) and your secondary style (second highest score).

I. Teaching style that allows students to experience and experiment with learning from within.

You enjoy listening to your students and attach a great deal of importance to focusing on them initially. Emphasis is placed on their needs, their motivation and their interests (security, feeling of belonging, self-esteem, curiosity, etc.). Your strategy prioritizes the values of your students. You are open to sharing your feelings and your personal experiences with your students. You try to personally involve yourself in their learning. You believe that learning can be pleasurable and do not hesitate to use teaching formulas that include games and activities that involve the student physically as well as mentally. You sometimes adapt your planned activities to the mood of the classroom. Some of the new educational strategies that you are, or would be, at ease with include the *Cooperative Approach*, *Role Play* and *Peer Learning*. Your teaching style is primarily compatible with students whose dominant learning integration style is Assimilation. It is not readily compatible with students whose dominant learning integration style is Application.

II. Teaching style that targets the construction of organized mental models.

You like to stress the intellectual development of your students. You like to provide intellectual challenges and encourage students to develop the intellectual capacities necessary to accurately assess complex problems and to pursue personal development. You tend to develop your courses around key concepts. Your evaluation tools often consist of open questions, debates, and essays. Among the new educational strategies, you are, or would probably be, at ease with *Case Study*, *Investigation* and *Simulation*. Your style of teaching is primarily compatible with students whose dominant learning integration style is Modeling. It is less compatible with students whose dominant style is Concrete Problem-Solving.

III. Teaching style that targets learning using proven methods and techniques.

You like to focus your teaching on reaching tangible and measurable results (learning in terms of observable behaviours, projects completed on time, quantifiable results, etc.). You seek to maintain a very structured and organized classroom that shows order and respect. You tend to plan everything meticulously and with precision. Discipline (strict but fair) usually reigns in your classroom. You are the students' principal source of information and you always try to give complete and detailed instructions on the tasks and work to be completed. Among the new educational strategies, you would be probably more at ease with *Mastery Learning* and the methods favouring *Programmed Instruction*. Your style of teaching is primarily compatible with students whose dominant learning integration style is <u>Application</u>. It is less compatible with students whose dominant style is Assimilation.

IV. Teaching style that focuses on learning how to solve real problems.

You encourage students to use their creative skills. You encourage innovative ideas and insight. You allow students to develop their own unique styles. You stress flexibility, imaginative practices and approaches to learning. You favour values such as personal curiosity and insight as well as personal, technical and artistic expression. Among the new educational strategies, you are or would be more at ease with *Problem-Based Learning* (PBL) and *Project-Based Learning*. Your style of teaching is primarily compatible with students whose dominant learning integration style is <u>Problem Solving</u>. It is less compatible with students whose dominant learning integration style is Modeling.

After a discussion on the results, the moderator can present the Investigation strategy using the corresponding information sheet in the appendix of this document.

Note For more information on forms of learning integration, please refer to: Guy Archambault, *Les pratiques enseignantes au niveau collégial Instruments auto diagnostiques*, Cégep Beauce-Appalaches, Regroupement des collèges PERFORMA, 1999, p. 136 to 142.

Learning Tool 3

Learning style of my students

This questionnaire identifies the learning style preferred by each student in a group. It is not an evaluation tool but rather allows each individual to recognize the learning integration styles he spontaneously favours and to identify the group's dominant style.

These nine questions are based on a questionnaire created by Kolb and Fry, inspired by Jean Piaget's concept of learning. A variation of the Kolb and Fry questionnaire can be found in a book by Lucie GAUTHIER and Norman POULIN, *Savoir apprendre*, Sherbrooke, Éditions de l'Université de Sherbrooke, 1983.

How to complete the questionnaire

The respondent assigns a certain number of points among the four options offered in each question. He repeats this procedure for each of the nine questions.

A. Start by giving a score of **4** points to the option, among the four offered, which best describes you. Write the number "**4**" in the appropriate place;

B. Next, score **1** point for the option, among the remaining three options, that describes you the least well. Write the number "**1**" in the appropriate place;

C. Then, allocate **3** and **2** points respectively to the remaining descriptions that fit you the most and the least. Write the numbers "**3"** and "**2**" in the appropriate places.

The context for each of the nine situations is identical: A. you are faced with a problem and you have all the resources needed to solve it; **B.** the resolution of the problem will bring you great personal satisfaction.

1. When an interesting problem arises, I am …:
   A. _____ selective;
   B. _____ deliberate;
   C. _____ committed;
   D. _____ practical.

2. When an interesting problem arises, I am …:
   A. _____ receptive;
   B. _____ pertinent;
   C. _____ analytical;
   D. _____ impartial.

3. When an interesting problem arises, I am …:
   A. _____ stimulated;
   B. _____ attentive;
   C. _____ deductive;
   D. _____ active.

4 When an interesting problem arises, I …:
   A. _____ remain well anchored in reality;
   B. _____ become daring;
   C. _____ weigh everything;
   D. _____ become meditative.

5. When an interesting problem arises, what takes precedence is …:
   A. _____ my intuition;
   B. _____ the number of observations I make;
   C. _____ my logic;
   D. _____ my inquisitive side.

6. When an interesting problem arises, I like to …:
   A. _____ remain realistic;
   B. _____ check the data attentively;
   C. _____ isolate what is essential;
   D. _____ act quickly.

7. When an interesting problem arises, I am …:
   A. _____ very present;
   B. _____ very absorbed;
   C. _____ very far-sighted;
   D. _____ very pragmatic.

8. When an interesting problem arises, I tend to …:
   A. _____ become emotionally involved;
   B. _____ scrutinize its many facets;
   C. _____ quickly schematize its structure;
   D. _____ observe the impact it produces.

9. When an interesting problem arises, I tend to …:
   A. _____ become focused;
   B. _____ take a step back;
   C. _____ reason things out;
   D. _____ feel responsible.

Compilation Grid

1. Each participant transcribes his answers to the nine questions into the grid below.
2. Each participant adds up the six scores in each column which are not preceded by an asterisk (maximum total per column: 24; minimum: 6).

		A	B	C	D
	1	*		*	
	2		*		*
	3				
	4		*		*
	5		*		*
	6	*		*	
	7			*	
	8				
	9	*			
	Total				
		CE	**RO**	**AC**	**AE**

CE = concrete experience versus **AC** = abstract conceptualization
AE = active experimentation versus **RO** = reflective observation

Interpretation

The questionnaire is not designed to compare students to each other. It is primarily an instrument to support professors in reflecting on their professional practices, by comparing preferred teaching styles (see results obtained from the questionnaire in Activity 2) with the predominant learning style of students in class.

It offers each student a better understanding of preferred learning integration styles that are spontaneous, and provides an opportunity to reflect upon them. When presenting the results, students can be introduced to the interpretation guide after their answers have been compiled.

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Interpretation Guide

CE = concrete experience <u>versus</u> **AC =** abstract conceptualization
AE = active experimentation <u>versus</u> **RO =** reflective observation

There are four methods of approaching a problem we want to resolve. If we combine the compatible methods (i.e. those which are not opposed), we get four combinations of dominant pairs. In compiling results, only these four dominant combinations are considered:

1. CE + RO = **2. AC + RO =** **3. AC + AE =** **4. CE + AE =**

In other words, we do not take into account the sum of **EC + CA** or **EA + OR**.

1. If, among the four pairs, the highest score is attributed to the **CE** + **RO combination**, then the preferred learning integration style is **Assimilation**. The student relies on his senses, emotions, feelings, intuition and what he experiences in the moment to construct his learning. This student may be the type to take a step back, to reflect and use subjective metacognition; he may not necessarily be rich in linguistic representations or connotations. He is in tune with his inner self. This learning style is dominant among artists (musicians, painters, dancers, etc.), athletes and sportspersons, hunters, trappers, people in situations that require personal reflection along with quick responses to what is happening in the moment (they prefer instinctive and sensory-motor interactions with reality). In a learning context, this style is usually preferred by first-timers in a discipline or new technique, those with little or no concrete references on the topic being discussed and those with very little pre-existing knowledge on the subject.

2. If the pair with the highest total is **AC** + **RO**, the preferred learning integration style is **Modeling**. The student relies on organized, coherent representations, rich in conventional and formally accepted languages (diagrams, drawings, graphs, synoptic tables, summaries, syntheses, table of contents, etc.) to construct his learning. He applies a 'reflective stepping back" and metacognitive approach to these representations; he constantly re-adjusts the organization of schemas and representations relative to a conceptual model shared with others. It is the preferred way of functioning and the active learning process of those who deal with constants and laws (researchers, legislators, senior executives, etc.) and those in situations that require an overall view of specific facts (they prefer suitable constructions of reality) in order to be effective. In a learning context, it is the preferred style of those with solid reference points in a given technical field or discipline, those fascinated by *the symbolic function of language*.

3. If the pair with the highest total is **AC** + **AE**, the preferred learning integration style is **Application**. The student relies on methodical and repetitive routines, techniques, protocol, or procedures for his learning to take root. A ‘step-back’ approach to these exercises enables him to control or adjust his actions and practices to fit a pre-established prescribed model. It is the preferred way of functioning and ongoing learning process for accountants, investigators, plumbers, electricians and all those who, in order to be effective, must integrate routines and protocols into their trade, profession or art. They must also meet generalized standards for the services they provide or the products they manufacture. (They prefer to adjust their interaction in the moment based on the needs of the people or the organization). In a learning context, this is the preferred style of those who already have many models in a given technical field or discipline and, either want or need to translate these into *concrete processes,* they need to have a constant and objective control over these operations.

4. If the pair with the highest total is **CE** + **AE**, the preferred learning integration style is **Problem solving**. The student relies on his interaction with objects, occurrences and people, using a reflective step-back approach, while constantly controlling and adjusting his interactions with what is relevant in terms of objectives. It is the preferred way of functioning and ongoing learning process of health professionals, community organizers, moderators, professors, contractors and all those who, in order to be effective, must rely on the constant re-adjustment of their interactions with customers or colleagues within a society or community organization (they adjust their interactions in the moment, based on the needs of the people or the organization). In a learning context, it is the preferred style of those who organize concrete data into mental representations or action. They can imagine new possibilities ‘here and now’ for gratuitous or problematical situations that arise. Armed with vast procedural knowledge and interacting within a complex system, they need constant and subjective control over their actions relative to the effects produced on the clientele with whom they interact face to face.

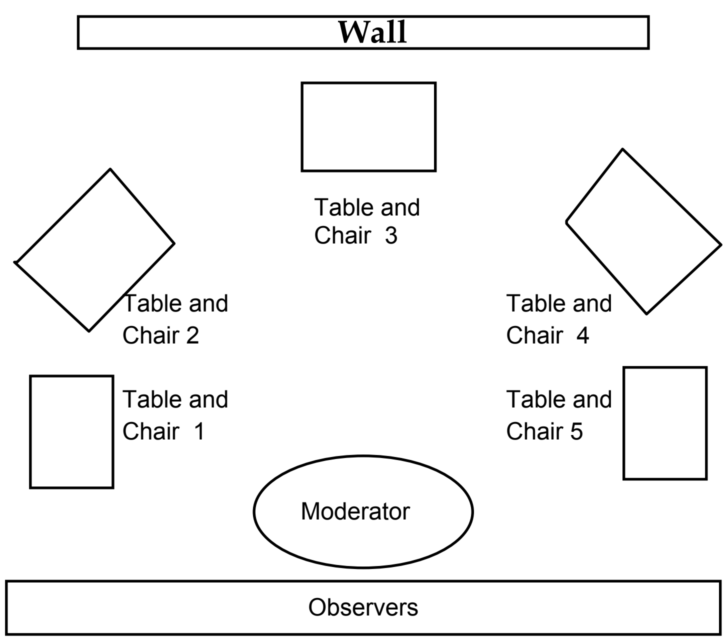
Learning Tool 4

The role of collective goal-setting in a *Cooperative approach*

The role of collective goal-setting in a cooperative approach

Step 1

The moderator places 5 chairs and 5 tables in a semi-circle as per the following diagram:



He places a set of identical white cardboard shapes on each table. Each of the five sets is composed of ten cardboards, numbered from **0** to **9** in large print that can easily be seen by all observers.

Step 2

The moderator explains the objective of the experiment: to understand the phases involved a problem-solving process (as identified by Kolb and Fry).

Step 3

The moderator picks five participants at random (or asks for five volunteers) to take part in the process. They will be given a team organization problem to resolve. The others will observe the process chosen by the participants to define and solve the problem.

Step 4

The moderator identifies the four steps of the problem solving process that the participants must respect: **a.** to experience the elements of the problem in a concrete manner; **b.** to define the nature of the problem; **c.** to find a solution; **d.** to test and implement the solution.

The moderator then explains that the experiment itself includes four stages and that stage one is preparatory. It is used to acquaint participants with the experiment and the rules of the game. The four stages will be followed by a collective review with the main group and the observers.

Step 5

The moderator briefly describes the four stages of the experiment.

- Going over the rules of the game to ensure proper understanding.
- Concrete understanding of the problem.
- Teamwork to define the problem and find a solution.
- Implementation of the solution to test its effectiveness.

Step 6

He asks the five volunteers to sit down (facing the wall with their back towards him) and study the set of cardboards. He stresses that strict observation of the rules of the game is necessary for the experiment to be successful.

Step 7

The moderator reads and clarifies the rules of the game.

A. "*There is only one period of time during which you are allowed to communicate among yourselves to define the problem and find a solution: this is in stage three. Until then, you may only ask questions to better understand the procedures and rules of the game or to check if you understood correctly.*"

B. “*In the second and fourth stages, only the moderator may speak. Moreover, in these two stages, you are not allowed to look at your four team mates or their cardboards.”*

C. “*In the first stage you are only allowed to ask questions to better understand the rules of the game.”*

Step 8

The moderator announces the beginning of stage one. Below is a word-for-word example of what he might say:

«I want each individual to choose a cardboard and raise it high so that I can easily see the number printed on it. Raise your cardboard only when I tell you to do so. To choose the cardboard, select the one whose number you think will best contribute to a number that I will call out five seconds before saying: - Raise your cardboards -.

Let's run through the exercise slowly to see if everyone understands. For instance, I say the number - five -. *You choose among the 10 cardboards in your set. To help you make your selection, ask yourself the following question:* which number chosen by me can best contribute to the total of the five cardboards adding up to “five”? *You have 5 seconds to choose:* **1, 2, 3, 4, 5**. *And now:* - Raise your cardboards -. *Let's calculate the total by adding all 5 raised cardboards: Total obtained? (If the answer is 5:* - That's correct! *if the answer is not 5:* - I don't have the requested total. -).

Let's carry out another test to determine if your comprehension is well anchored....

At this stage the moderator uses only multiples of "5".

When each of the five participants understands the procedure and the rules of the game, the moderator announces that he will proceed to the second stage. He reminds them that this step demands absolute silence and that none of the five participants is allowed to look at his team mates or their cardboard.

Step 9

The moderator asks an observer to write in the table below each requested number and the result obtained when the cardboards are raised. He then proceeds to the problem-solving experiment by calling out the following 8 numbers, in the order shown and according to the procedure described.

Number called			
21	Wait five seconds	«Raise your cardboards! »	«Result? ».
22	Wait five seconds	«Raise your cardboards! »	«Result? ».
43	Wait five seconds	«Raise your cardboards! »	«Result? ».
44	Wait five seconds	«Raise your cardboards! »	«Result? ».
12	Wait five seconds	«Raise your cardboards! »	«Result? ».
18	Wait five seconds	«Raise your cardboards! »	«Result? ».
4	Wait five seconds	«Raise your cardboards! »	«Result? ».
37	Wait five seconds	«Raise your cardboards! »	«Result? ».

Step 10

The moderator announces the beginning of stage three. He asks the five team mates to work together to define the problem and find a practical solution, which will be tested at the next stage. They may take all the time they need.

Each observer has a choice at this time: either he chooses to observe the group of five, or he moves aside with one or two other observers to define the problem and find a solution.

Step 11

The moderator proceeds to the fourth stage as soon as the team of five participants is ready to experiment and test their solution. He repeats the same process as in step 9.

Number called			
24	Wait five seconds	"Raise your cardboards!"	"Result?"
26	Wait five seconds	"Raise your cardboards!"	"Result?"
41	Wait five seconds	"Raise your cardboards!"	"Result?"
44	Wait five seconds	"Raise your cardboards!"	"Result?"
33	Wait five seconds	"Raise your cardboards!"	"Result?"
11	Wait five seconds	"Raise your cardboards!"	"Result?"
2	Wait five seconds	"Raise your cardboards!"	"Result?"
37	Wait five seconds	"Raise your cardboards!"	"Result?"

Step 12

If the test is successful, the moderator then proceeds to review the experiment and present the Kolb and Fry learning process as well as the C*ooperative approach* using the corresponding sheet (problem solving workshop) found in the appendix of this section.

If the test is not successful, he can give the team five minutes to readjust its choices, before reviewing the activity. He then conducts a test with four numbers that are not multiples of 5.

Learning Tool 5

Case study and problem solving

Unfolding

1. The moderator explains the goal of the case study.

2. The moderator gives each participant a copy of the case study and the list of candidates.

3. The moderator divides the group into teams of five to seven people. He asks each team to hold their first committee meeting and complete the required task within 25 minutes.

4. The moderator reassembles the teams and asks if they have already decided who would be the best person to work at the Centre.

5. Each team can ask 3 questions of the Executive Director. The moderator writes them down on the board. He then classifies them according to the 4 poles listed below: (without writing the name of the poles on the board):

Pole 1 – Any question designed to obtain more information on customer characteristics, needs and lifestyle.

Pole 2 – Any question designed to obtain more information on the mission of the Centre, its objectives and development priorities.

Pole 3 – Any question designed to obtain more information on resources already available (human, material and financial).

Pole 4 – Any question designed to obtain more information on the Centre's management style (flow chart, collective agreement, salary scale, schedules, etc.).

6. The moderator reviews the questions on the board, comparing the questions asked about the needs of the recipients and the objectives of the Centre, to those about available resources or the Centre's management and organizational style.

7. The moderator then provides additional information.

8. He asks each individual to make a final choice on the best "*pre-interview*" candidate.

9. The moderator reviews the experiment in light of the desired objectives, more specifically as concerns the *Case study,* with the help of the appropriate form provided in the appendix.

Case study

The director of a 100-bed medical centre for long-term care has invited you to be a member of their selection committee. The task of the committee is to choose one candidate among 7. The curriculum vitae are found in the following pages. The hospital's board of directors did not provide a very detailed description. In fact, the ad published in the newspaper simply stated:

Employment Opportunity

Le C.H.S.P. in Gatineau requires a full-time health-sciences professional to work as a specialist in his field with senior residents of the centre, and to act as resource person for the staff members assigned to patient care.

Applicants for the position must hold a diploma in geriatrics or gerontology and have relevant experience in one or more professional fields related to the health of senior citizens.

A good mastery of French and English is a prerequisite for the position.

It is quite obvious the committee needs additional information in order to be able to make the proper selection. What essential information is missing?

The team plays the role of the selection committee. At its first meeting, their task is to draw up an exhaustive list of all the information they need from the Executive Director in order to fulfill their mandate, and a list of key additional information to be obtained from the candidates during the interview to better differentiate among them. The Executive Director has never met the candidates and the only information available to him, as well as to you, is provided in the following CVs.

Once the meeting is over (25 minutes), you will ask the Executive Director the three questions you consider the most important to making your selection (the moderator will play the role of the Executive Director at this stage).

Candidates

Lelong, Aline
Born on July 14, 1947. Gynaecologist. In private practice in Montreal since 1962, she obtained a graduate degree in gerontology in 1987. Her clientele consists mainly of elderly women. She possesses excellent mastery of French and speaks a bit of English.

Lelarge, Bilia
Born on December 25, 1952. A nurse at the Sherbrooke University Medical Centre since 1972, she obtained a graduate degree in gerontology in 1982. She possesses excellent mastery of both official languages.

Lecourt, Cilia
Born on May 1, 1942. Audiologist and speech-language therapist at Sainte-Justine since 1972, she obtained an undergraduate degree in gerontology in 1983. She is equally at ease in French, English and Italian.

Moyin, Dorak
Born on July 4, 1957, in Jordan, he immigrated to Canada in 1982. Since then, he has obtained a bachelor's degree in chiropractic medicine, a master’s degree in psychology and a certificate in gerontology. At his private office in Montreal, he serves customers in Russian, Chinese, English and French.

Petit, Evelyne
Born on July 1, 1972, she obtained a bachelor's degree in nursing in 1994 and a master's degree in gerontology in May 1996 in Paris. She is fluent in Italian, French and English.

Legros, France
Born on January 1, 1962, she has been a dietician at senior residence in Québec since 1987. She obtained a master's degree in gerontology from the University of Toronto in 1984 and is fluent in Spanish, French and English.

Legran, Gersh
Born on June 24, 1962, in Brussels, he obtained a master's degree in geriatrics in 1991 in Louvain. In Montreal since 1985, he practices in an office that serves German, English and French customers.

Information on the Gatineau C.H.S.P. available to the Executive Director

1. Basic clientele characteristics:

70 women, 30 men: between the ages of 55 and 88.
28% have serious hearing or speech problems. 34% require special diets as a result of the removal of digestive organs. 67% are bedridden 24 hours a day, 7 days a week.

English-speaking versus French-speaking: approximately 50-50.
All come from low income housing areas; they receive very few visitors.
The C.H.S.P. provides not only a variety of services but also a home environment for its clientele.

2. Description of existing human resources:

The nursing staff is very qualified. However, there seems to be a lack of knowledge and adapted practical care of the elderly.

There are many services available to recipients: two full-time general practitioners, a full-time dietician, a part-time nephrologist, a part-time gynaecologist as well as a part-time audiologist/speech-therapist.

3. C.H.S.P. objectives for the coming year taking into account the preceding points:

- To increase resident mobility and reduce the number of completely bedridden residents to 50%. This means increasing the relatively mobile by 17.

- To teach residents to help each other rather than always call on the nursing or medical staff.

- Reorient for care or research purposes, resources that are currently taken up mainly by patient transportation and counselling services

- To promote an ongoing research-action mentality among health professionals in an effort to provide new and diversified care-giving elements adapted to the Centre's elderly residents.

Learning Tool 6

Mediation and the zone of proximal development

First step

After briefly reviewing the goals of the activity, the moderator carries out a demonstration of the problem to be solved, indicating that each individual must discover and master the algorithm of the problem even if this means getting help from colleagues during the teamwork stage.

A. He gathers all the participants around him and places twelve charts, each containing 6 different symbols on the table (see procedure for drawing up material at the end of this section). He then writes on a piece of paper, without anyone's knowledge, one of the nine symbols (or its colour). He then asks someone to try and identify this symbol while respecting the following rules:

- A maximum of four questions are allowed, one at a time.
- The question to be asked is always the same: "*Can the symbol written on the piece of paper be found on card number X*?" This is the only type of question allowed. The only variable in all 4 questions is the card number (X).
- For each question, the moderator answers only with a simple "*yes*" or "*no*".

B. He then states that the hidden symbol can be found in four logical questions or less assuming the right card is chosen at the start of each turn.

C. The participant asks his first question; the moderator answers "*yes*" or "*no*". The participant asks his second question, etc.

D. After the fourth question has been answered, the moderator asks the participant which symbol is written on the paper; he then reveals the symbol.

E. The moderator then checks to see if the participants understood the rules of the game (the three rules to be respected) and the objective (each individual must find and master the algorithm of the problem as described). Depending on the answer received, the moderator clarifies the rules and the objective.

F. If the group is composed of more than 11 people, the moderator creates teams of 6 to 9 people taking care to distribute evenly among the teams those participants who do not seem to understand the objective or rules of the game (or those exhibiting resistance to this kind of game or problem).

Second step

Before the teams get to work, the moderator points out that at the end of thirty minutes, each individual must have found and identified the algorithm. He indicates that each team is free to adopt the procedure that best allows them to reach the desired result. And that those who are more gifted for this type of problem should assist those who are less gifted.

Third step

The moderator gathers the teams and checks to ensure that all participants have found and identified the algorithm. When the group is ready to proceed to a review of the experiment, he then requests that everyone maintain silence so that each individual can:

- remember the moment when he began to understand the algorithm;
- remember the moment when he felt sure he had mastered the algorithm;
- identify any internal and/or external events that helped him.

After two or three minutes of silence, he begins the review with the following questions:

- Which internal or external events helped you solve the problem?
- When did these events occur?
- Which behaviours helped? Which ones hindered?
- Under which conditions can you use the assistance of peers in the classroom?

The moderator then introduces, at the appropriate time, a short presentation on one of the two following topics (or both): -*mediation* - *zone of proximal development*, using the optional reference materials, *Theoretical text 3* and the *Foreword* to the 15 texts.

Creating the twelve cards.

1- Prepare a set of twelve laminated cards for each team.
2- Each of the twelve cards will contain six symbols chosen among nine.
3- Each symbol has one colour, always the same but different from the other symbols.
4- Each symbol is always found in the same place on the card.
5- Each symbol must be included on exactly eight of the twelve cards.
6- Each card must be different from the eleven others.
7- The nine symbols can be those below. The symbols can be replaced by stickers, as long as they comply with the six preceding rules.

#	$	%
&	@	=
∂	€	□

8- The following pages illustrate how to arrange the symbols on the twelve cards so that there are six symbols per card, and that each symbol appears eight times in the set of twelve cards.

Card 1

		%
	@	=
∂	€	�

Card 2

#	$	%
&	@	
∂		

Card 3

#		
&	@	
∂	€	�

Card 4

#	$	%
	@	=
		�

Card 5

#	$	%
&		=
	€	

Card 6

	$	
&		=
∂	€	�

Card 7

\# $

& =

€ �

Card 8

$ %

& =

∂ €

Card 9

\#

@ =

∂ € �

Card 10

$ %

& @

∂ �

Card 11

%

&	@	
	€	�

Card 12

#	$	%
	@	=
∂		

Learning Tool 7

Teamwork and decision-making

Procedures to follow

Complete the table on the next page using the following general question:

Taking into account the definition of an adult (see below), which of the *17 principles* (established by psychologists, sociologists and renowned adult education specialists), apply *to you personally* and which ones apply *to young adults who make up the majority of cégep students?*

1. Place a checkmark in column "**1**" if the principle is applicable to you. Place a checkmark in column "**2**" if the principle applies to cégep students.

2. Achieve a consensus for each of the 17 principles (column "**2**"), using your individual answers as a starting point.

3. Brief definition of a human adult

There are four characteristics that define the essence of adulthood:

- The adult individual, as with most animal species, has reached and probably crossed the threshold of physical maturation.
- The adult has reached a level of psychosocial maturation which allows him to assume responsibility for the satisfaction of his needs: physical, socioaffective, sense of purpose, personal expression, leisure, culture, vocation, etc.
- The adult is expected to share responsibility, to a limited extent, for satisfying the needs of other family members and in a broader sense, those of a local or national community.
- As he ages, the adult can fall back on an increasing amount of meaningful experiences to orient himself with regard to choices that must be made.

Once a consensus is obtained, the moderator will initiate a review of the process used and introduce Problem-Based Learning (PBL).

Important information on team decisions

A *consensus* is more than a *majority*. It is a work in progress towards unanimity. All team members must agree and base their decision on an understanding that is shared and accepted by each member.

	Individual response		**team response**
Principles	me	student	
1- Learning is an active process that engages an adult in every dimension of his being: emotional, intellectual etc.			
2- An adult can recognize the characteristics of his learning style.			
3- An adult is in control of his own learning process.			
4- Learning is a natural evolutionary process that increases adult independence.			
5- An adult can transcend his learning process to extract rules and principles that guide him.			
6- Adult learning tends to be centered on particular themes or interests.			
7- An adult structures his learning based on personal choices (rather than objectives established by others).			
8- For an adult, acquired experience is at the core of the dynamics in his learning process.			
9- The adult learning process alternates between reflection and action.			
10- An adult gets involved more readily in a learning activity when it is felt as meaningful or relates to his experience and aspirations.			
11- An adult only discovers his true learning objectives when he acquires knowledge and basic skills in a given field of study.			
12- An adult continuously readjusts his learning to match his evolving needs, interests and changes in context.			
13- The adult evaluates his expertise based on the concrete results that he gets.			
14- The more an adult specializes in a field, the greater his interest for that field.			
15- An adult learns better in a framework that offers varied teaching formulas.			
16- Adults like to learn through action and doing.			
17- An adult likes to control his own learning rhythm, (i.e., decide for himself when to start and finish an activity).			

Learning Tool 8

The project

Survey on teaching practices

Protocol for completing
Questionnaire on professional teaching practices

Content and questionnaire objectives

The questionnaire enumerates 48 teaching practices that research has shown to help to students learn in a classroom environment. The questionnaire is designed to get your opinion on the subject.

Procedures to follow for completing the questionnaire

Before answering the questionnaire, all 48 statements can be looked over. A preliminary reading can be useful because the meaning of each statement is often made clearer through the reading of a series of statements.

Rate each statement using the following scale:

3 = you believe the teaching practice is **very useful** to learning in class.
2 = you believe the teaching practice is **useful** to learning in class.
1 = you believe the teaching practice is **not very useful** to learning in class.
0 = you believe the teaching practice is **not useful at all** to learning in class.

Rating **3** = very useful **2** = useful **1** = not very useful **0** = not useful at all

Professional teaching practices	
1- The professor informs us about the realities facing us when we finish our program of studies.	
2- He finds ways to identify us individually as students (questionnaires, interviews, informal meetings, etc.).	
3- He positions his course relative to other courses in our program of studies.	
4- He identifies the course's evaluation criteria.	
5- He takes time to establish connections between his teaching approach and course objectives.	
6- He communicates his course plan in a language we understand.	
7- He helps us define personal learning objectives.	
8- He explains how completing the learning activity is useful for developing our competencies.	
9- He positions each learning activity within the overall course plan.	
10- He clearly spells out the procedures for completing the learning activities (individually or in teams).	
11- He tells us in advance how long the learning activities will take (individually or in teams).	
12- He lets us know exactly what is expected work-wise (individually or in teams) using examples, models and precise demonstrations.	
13- He creates a climate of confidence, right from the start.	
14- He identifies the few simple rules classroom rules (absences, lateness, right to speak, etc.).	
15- He remains *true* to himself in his professional role i.e., shares his experience and values, uses humour in the classroom, is ready to discuss with us after class, etc.).	
16- He has a warm and welcoming attitude towards us.	
17- He addresses us by our surname or given name.	
18- He communicates with us in a conversational manner rather than in a scholarly lecture style.	
19- He involves us in decisions which concern us.	
20- He allows us great freedom of choice, i.e., how we accomplish the work, the distribution of tasks in a team, the type of work to be done, etc.	
21- Occasionally, he summarizes at the beginning of class the material covered in previous classes.	
22- He relates new information and skills to our prior knowledge and what is familiar to us.	
23- Occasionally, he asks us to prepare a summary, create a table or a diagram to review the newly acquired learning.	
24- When he asks us questions as a group, he gives us time to answer most of the questions by ourselves.	

Rating 3 = very useful 2 = useful 1 = not very useful 0 = not useful at all

Professional teaching practices	
25- He varies the format of his presentations, i.e., multi-media, conferences, debates, panels, films, musicals or theatrical plays, informal presentation, etc.	
26- He uses activities that facilitate the exchange of ideas and work in teams.	
27- He uses varied learning activities.	
28- He uses learning activities that require the use of knowledge and skills learned previously in the course.	
29- He checks up on our understanding of what is being said and done in class, by asking questions from time to time.	
30- He asks us describe aloud, the reasoning and strategies we used to solve the problems brought to our attention.	
31- He follows up with individual support as required.	
32- He helps us understand the causes of our successes and our failures.	
33- He provides us with self-evaluation tools so we can gauge our own learning progress.	
34- He helps us make necessary adjustments to our work methods (taking notes, time management, study techniques, etc.).	
35- He provides us with feedback on work carried out in class, so we can readjust immediately.	
36- He provides us with meaningful written comments on work completed outside the classroom.	
37- He recommends various ways for us to overcome difficulties in completing activities.	
38- He adapts his communication style when we are emotionally involved.	
39- His rules concerning classroom behaviour are flexible when unusual situations arise.	
40- He alternates his presentations and demonstrations with learning activities which we carry out ourselves.	
41- He connects new learning experiences to what was previously learned.	
42- He evaluates only the important aspects of the course.	
43- He communicates the subject matter and the evaluation criteria, at the start of the session.	
44- He clearly communicates the subject matter and the evaluation criteria.	
45- He reminds us from time to time during the course, of the subject matter and criteria for evaluation.	
46- He seldom uses the summative evaluation.	
47- He avoids using the summative evaluation for purposes other than learning activities, i.e., to maintain attendance in class.	
48- He takes into account our feedback on his teaching style.	

Compilation and interpretation guide for the
Questionnaire on professional teaching practices

I. Table 1
Compilation

a. Transcribe the sum of the ratings by the respondents into the *Total* column, for each practice.
b. Divide each *Total* by the number of respondents and place this number in the *Average* column, for each practice.

Interpretation

The first table makes it possible to analyze student opinion on the usefulness of seven* out of eight professional teaching competencies required for managing one's teaching practices. These competencies are: (*only competency B is not covered by the questionnaire):

A. To establish objectives based on the desired learning.
B. To select a teaching approach suitable for the development of the targeted learning objectives.
C. To clarify the goal of the teaching practice for students.
D. To create the necessary conditions for the emergence of motivation intrinsic to learning.
E. To use a teaching approach that supports the progressive integration of learning.
F. To provide students with relevant feedback on their acquired knowledge and learning process.
G. To adapt the practice to what is occurring in the moment.
H. To evaluate the results of the practice and the pedagogical approach used.

The table also allows us to identify practices that are more or less useful to learning, from the student's point of view. In the *Average* column, find the five highest averages and the five lowest values. The highest averages indicate the learning practices the students find the most useful. Conversely, the lowest averages underscore the practices which they consider the least useful in their learning process.

II. Table 2

Compilation

The numbers already entered in table 1 are used to complete table 2.

a. Transcribe the numbers shown in the *Average* column of table **1** to the average column for each practice, in table **2**.
b. Total the averages for each of the columns in table **2.**
c. Divide each of these totals by the number of practices listed in the column (this number is indicated on the last line of each column in table **2**).

Interpretation

Table **2** allows us to identify the extent to which students consider useful, teaching practices that prove to be more supportive of in-depth learning. The final averages show the degree of usefulness of each of the dimensions listed below. The closer the average is to 3, the more the students find the dimension useful; the closer the average is to 0, the less the students find it useful.

The five dimensions of in-depth integration of learning are: assimilation (**AS**), modeling (**MO**), application (**AP**), problem solving (**PS**) and regulation (**RE**).

If we had to summarize the essence of learning integration in one word, we would speak about anchoring or, more precisely, a double anchoring: the anchoring of a new acquisition within the person; and the anchoring of the person possessing the new knowledge into reality. The integration of learning is a process of **internalization** and a process of **externalization**.

When learning something new, an individual makes a model of it. This allows him to act on it, or with it, within his environment. This biological reality cannot be overlooked: living beings that need to move and act within their environment are equipped with a complex nervous system and a brain. The brain allows the being to act within and on its environment. It does this in an effective manner thanks to its representations/models of reality. Thus the purpose of knowledge is action.

This means that an integrated person possesses adequate representations/models of the physical and social environments in which he evolves and can also interact effectively in this environment. His integration proceeds harmoniously.

Some practices enable in-depth and long-term integration of learning by supporting one or more of the five following processes:

A. **Assimilation** in long-term memory cells, a process whereby sensory and cerebral activity interacts constantly to support engrammation into the neuronal tissue;
B. Constant **Modeling** of the acquired knowledge to support the creation of neural networks of complex models;
C. Constant **Application** of the acquired knowledge to concrete, familiar, and everyday situations to ingrain learning and build progressively new personal knowledge which is at once implicit, automatic and spontaneous;
D. **Problem solving** to support the transfer of acquired knowledge to new situations;
E. **Regulation** of the intended actions based on metacognition, i.e., taking a step back to think about these models and actions.

These five integration processes are not carried out in a linear, chronological order. However, the assimilation of units precedes their modeling, just as problem solving is more successful when opportunities to use the technique are frequent and involve familiar situations. This varied iteration tends to assimilate and gradually engram a psycho-sociological pattern, i.e. a flexible and malleable structure of potential actions:

- that happen in sequence,
- that are ready to be used spontaneously in the moment,
- that are based on the situation encountered.

For a greater appreciation of the results, we recommend reading the three booklets of the *Questionnaire sur les pratiques professionnelles enseignantes* by **Archambault G.** and **Aubé R.** published in August 2000 at Collège Shawinigan by Regroupement des collèges PERFORMA. This document is available at your library or through your regional PERFORMA representative.

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After a discussion on the results, the moderator can present the strategy of Investigation and the Project seminar with the help of the corresponding cards found in the appendix of this section.

Name of classroom- group: ____

Table 1

Competency and practice	*Total*	*Average*	**Competency and practice**	*Total*	*Average*
A- 1			F- 29		
A- 2			F- 30		
A- 3			F- 31		
A- 4			F- 32		
A- 5			F- 33		
			F- 34		
C- 6			F- 35		
C- 7			F- 36		
C- 8			F- 37		
C- 9					
C- 10			G- 38		
C- 11			G- 39		
C- 12			G- 40		
			G- 41		
D- 13					
D- 14			H- 42		
D- 15			H- 43		
D- 16			H- 44		
D- 17			H- 45		
D- 18			H- 46		
D- 19			H- 47		
D- 20			H- 48		
E- 21					
E- 22					
E- 23					
E- 24					
E -25					
E- 26					
E -27					
E- 28					

Table 2
Perception of the usefulness of practices that support learning integration

Assimilation		**Modeling**		**Application**		**Problem solving**		**Regulation**	
Practice	Average **B***	Practice	Average **B***	Practice	Average **B***	Practice	Average **B***	Practice	Average **B***
								7	
		6						29	
		9		11		20		32	
8		10		12		23		33	
25		21		24		26		34	
27		22		30		28		35	
31		41		40		37		36	
total		total		total		total		total	
divided by 4		Divided by 6		divided by 5		divided by 5		divided by 7	

* Enter the averages listed in table **1**

Learning Tool 9

The division of roles in teamwork

Objective

To establish a common vocabulary regarding the roles to be assumed in teamwork, within the context of *a Collective project* in the classroom.

Process

Each participant completes each of the fifteen sentences listed on the following page with the name of one of the five subjects proposed. The context is that of a team of 5 students working on a collective project.

Once this individual work is finished, the team works towards a consensus. A consensus implies that all members agree with each of the fifteen sentences. The object is not to work towards a consensus, but to reach one. A majority or a "*unanimous vote save one*" is not acceptable. A consensus is seldom reached spontaneously; it is reached through exchanges and discussion. (The consensus is an educational strategy for developing coherence and cohesion within the team. In *real life*, a consensus is reserved for scenarios where the existence and survival of a group is at stake.)

Answers given by the team can be compared to the answers given by the resource person.

After a discussion on the results, the moderator can introduce the strategies for the Project seminar and the Problem solving workshop using the corresponding cards found in the appendix.

Among the five roles listed here, select the one that best fits each of the fifteen statements: 1. *moderator;* 2. *expert;* 3. *group representative;* 4. *natural leader;* 5. *secretary.*

1. He always has priority over others when it comes to speaking in a meeting. ____________

2. He can crush others with the strength of his personality. ____________

3. He should be more at ease than others with the discussion procedures. ____________

4. He is usually better informed than others on the subject being discussed; he has information that others don’t and shares that information with the team at the opportune moment. ____________

5. He can be useful insofar as we really want to call on his resources regarding the subject matter being studied. ____________

6. He usually participates more actively than others in preparing the agenda for team meetings. ____________

7. He can be an excellent moderator insofar as he does not use his prestige to direct the thinking of the team. ____________

8. He can speak for the team and represent it on the outside. ____________

9. He can act as collective memory for the team and be used to recall previous decisions made by the team. ____________

10. He can easily win over to his way of thinking those who feel less involved. ____________

11. He risks hindering the participation of others who do not have as much knowledge as him. ____________

12. He feels responsible for the discussion procedures. ____________

13. He must be well accepted by the others to function adequately. ____________

14. He is ill-suited to assume the role of secretary for the group. ____________

15. He can facilitate team cohesion provided he is conscious of his influence and the limitations of his role. ____________

Correct answers for activity 9

1. He always has priority over others when it comes to speaking in a meeting.	Moderator
2. He can crush others with the strength of his personality.	Natural leader
3. He should be more at ease than others with the discussion procedures.	Moderator
4. He is usually better informed than others on the subject being discussed; he has information that others don't and shares that information with the team at the opportune moment.	Expert
5. He can be useful insofar as we really want to call on his resources regarding the subject matter being studied.	Expert
6. He usually participates more actively than others in preparing the agenda for team meetings.	Secretary
7. He can be an excellent moderator insofar as he does not use his prestige to direct the thinking of the team.	Natural leader
8. He can speak for the team and represent it on the outside.	Representative
9. He can act as collective memory for the team and be used to recall former decisions made by the team.	Secretary
10. He can easily win over to his way of thinking those who feel less involved.	Expert or Natural leader
11. He risks hindering the participation of others who do not have as much knowledge as him.	Expert
12. He feels more responsible than others for the discussion procedures.	Moderator
13. He must be well accepted by others to function adequately.	Moderator or Representative
14. He is ill-suited to assume the role of secretary for the group.	Moderator
15. He can facilitate the cohesion of the team provided he is conscious of his influence and the limitations of his role.	Natural leader or Representative

Learning Tool 10

Individual work, teamwork and formative evaluation

Cash account

An unknown person approaches you in a crowd and says:

"Here's my very short summary report of the event.

A businessman had just turned off the light in the store when an individual appeared suddenly and demanded money. The owner opened a cash register. It was emptied of its contents and the individual left as fast as he could. A policeman was quickly alerted."

After saying this, the person disappears in the crowd.

Read the following eleven comments made by other people about this event. Your information is limited but it is reliable (the unknown person is not lying). Given this, place a checkmark after each sentence to indicate whether it is true (**T**), or false (**F**) or (**?**) if you don't know.

Comments	**T**	**F**	**?**
1. An individual appeared after the owner turned off the light in his store.			
2. The robber was a man.			
3. The individual did not ask for money.			
4. The person who opened the cash register was the owner.			
5. The owner of the store grabbed what was in the cash register and fled.			
6. Somebody opened a cash register.			
7. After the individual who asked for money grabbed what was in the cash register, he fled.			
8. Although the cash register contained money, it is not mentioned how much.			
9. The robber demanded money from the owner.			
10. The event comprises a series of facts in which only 3 people intervene: the owner of the store, the individual who requests money and the policeman.			
11. The following facts are accurate: somebody asked for money, a cash register was opened, someone grabbed what was inside and a man fled from the store.			

Keep this copy for your teamwork.

Transcribe your answers on the following sheet and give to the moderator.

Individual answers (copy to be given to the moderator)

Comments	**T**	**F**	**?**
1. An individual appeared after the owner turned off the light in his store.			
2. The robber was a man.			
3. The individual did not ask for money.			
4. The person who opened the cash register was the owner.			
5. The owner of the store grabbed what was in the cash register and fled.			
6. Somebody opened a cash register.			
7. After the individual who asked for money grabbed what was in the cash register, he fled.			
8. Although the cash register contained money, it is not mentioned how much.			
9. The robber demanded money from the owner.			
10. The event comprises a series of facts in which only 3 people intervene: the owner of the store, the individual who requests money and the policeman.			
11. The following facts are accurate: somebody asked for money, a cash register was opened, someone grabbed what was inside and a man fled from the store.			

Team answers

Starting from individual answers, build a team consensus for each of the eleven statements. A consensus implies that everyone agrees with the answer given. A majority or "*unanimous vote save one*" is not acceptable. Each team member must be prepared to explain and defend the answers given by the team.

Comments	**T**	**F**	**?**
1. An individual appeared after the owner turned off the light in his store.			
2. The robber was a man.			
3. The individual did not ask for money.			
4. The person who opened the cash register was the owner.			
5. The owner of the store grabbed what was in the cash register and fled.			
6. Somebody opened a cash register.			
7. After the individual who asked for money grabbed what was in the cash register, he fled.			
8. Although the cash register contained money, it is not mentioned how much.			
9. The robber demanded money from the owner.			
10. The event comprises a series of facts in which only 3 people intervene: the owner of the store, the individual who requests money and the policeman.			
11. The following facts are accurate: somebody asked for money, a cash register was opened, someone grabbed what was inside and a man fled from the store.			

Correct version

Comments	T	F	?
1. An individual appeared after the owner turned off the light in his store.			X
2. The robber was a man.			X
3. The individual did not ask for money.		X	
4. The person who opened the cash register was the owner.	X		
5. The owner of the store grabbed what was in the cash register and fled.			X
6. Somebody opened a cash register.	X		
7. After the individual who asked for money grabbed what was in the cash register, he fled.			X
8. Although the cash register contained money, it is not mentioned how much.			X
9. The robber demanded money from the owner.			X
10. The event comprises a series of facts in which only 3 people intervene: the owner of the store, the individual who requests money and the policeman.			X
11. The following facts are accurate: somebody asked for money, a cash register was opened, someone grabbed what was inside and a man fled from the store.			X

Based on the report provided by the stranger, the only statements that are true are the fourth and the sixth and the only one which is false is the third. In light of the brevity of the report, all the other statements could be either true or false; we cannot therefore assess them as being either true or false.

After a discussion of the results, the moderator can introduce a strategy, the Problem solving workshop, using the corresponding card found in the appendix of this section.

Compilation table
to compare
average number of correct individual answers
to average number of correct team answers

Total number of correct individual answers	Total number of participants	Average number of correct individual answers
Total number of correct team answers	*Total number of teams*	*Average number of correct team answers*

A number of formative evaluation examples as applied to cégep students can be found in a book by **Ulric Aylwin**, *La différence qui fait la différence*, AQPC, Montréal, 1992. Other examples can be found on pages 59, 65, 66, 67, 69, 71, 76, 77, 82 and 88 of the book by **Guy Archambault,** *47 façons pratiques de conjuguer enseigner avec apprendre*, 2nd Edition, Les Presses de l'Université Laval, Sainte-Foy, 2001.

Learning Tool 11

The role of perception in learning

Step 1 First experiment

1. For each of the following words spoken at 30-second intervals (except in the case of the first word which has a 45-second pause), ask the participants to:

- be aware of what the word spontaneously evokes in them;
- take a few seconds to explore what has been evoked;
- using the rating sheet provided for this purpose, rate the word on each of the seven antonym scales, based on how close it is to either of the two poles.

1. Forest 2. Synthesis 3. Star 4. Obligation 5. Clock 6. Process 7. Cloud 8. Solution 9. News 10. Virus

2. When all 10 words have been rated, each participant is asked to join with one or two of his colleagues to: **a)** compare the individual ratings for each word by explaining the reasons for the rating, in particular when the same word presents a strong opposite rating; **b)** try to find as many reasons as possible to explain the phenomenon of strong opposite ratings.

3. At a plenary session, after collecting the rating sheets, the moderator invites the participants to exchange views on three questions: **a)** Was it easy to rate the words? **b)** What are the reasons for strong opposite ratings? **c)** How do you apply this to what occurs in the classroom?

Step 2 Second experiment

The moderator uses the corresponding rating sheet for the second experiment. He asks participants to count the number of vowels in a list of ten words and to place a checkmark in the appropriate box; then he also asks them to indicate by a checkmark whether they "like" or "do not like" the word.

Step 3

He collects the sheets and asks the participants to write down on a separate sheet of paper, all the words they remember from the first list (the first experiment). Participants have two minutes to do this. He then asks the participants to count the number of words they remember and he writes down on the board, how many students remembered seven words or more. (He may also show the original list at this time).

He proceeds in the same way for the second and third list of words so that he may compare the memorization results for all three lists. He then asks participants to explain why there may be differences in the results. Finally, he makes a presentation on the role of perception in learning.

An individual's perception relative to an object is a result of:

- his need to quickly create a model of it;
- his past experience in relation to it;
- the current context in which he sees it;
- his own emotional, 'valued' or motivational relationship to the object.

First experiment
Rating sheet for the 10 words

Write each word when it is announced, then rate it on each of the 7 scales.

First word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Second word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Third word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Fourth word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Fifth word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Sixth word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Seventh word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
Soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Eighth word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
Soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Ninth word ____________________

cautious	3	2	1	0	1	2	3	Daring
cool	3	2	1	0	1	2	3	Warm
soft	3	2	1	0	1	2	3	Fast
responsible	3	2	1	0	1	2	3	Free
unknown	3	2	1	0	1	2	3	Familiar
stable	3	2	1	0	1	2	3	New
probable	3	2	1	0	1	2	3	Certain

Tenth word ____________________

cautious	3	2	1	0	1	2	3	daring
cool	3	2	1	0	1	2	3	warm
soft	3	2	1	0	1	2	3	fast
responsible	3	2	1	0	1	2	3	free
unknown	3	2	1	0	1	2	3	familiar
stable	3	2	1	0	1	2	3	new
probable	3	2	1	0	1	2	3	certain

Second experiment

Count the number of vowels in each of the ten words below and place a checkmark in the correct box.

		3 vowels	2 vowels		3 vowels	2 vowels
	fishing			sugar		
	outlet			tomato		
	display			friend		
	blue			record		
	river			weed		

Rate each of the ten words below by placing a checkmark in the box of your choice: *"I like this word"* or *"I do not like this word"*.

Please be spontaneous

		I like this word	I do not like this word		I like this word	I do not like this word
	tree			hen		
	shirt			table		
	beach			people		
	moon			book		
	radio			mouse		

Learning Tool # 12

Panel

Opinion questionnaire

Using the scale provided, indicate your level of agreement with the following 10 statements:

0	1	2	3
Completely disagree	**Mostly disagree**	**Mostly agree**	**Completely agree**

1. Increasing student success rate at collegial level will inevitably bring about a reduction in the "quality standards" of my summative evaluation process. ________
2. Adopting new educational strategies to make students active in class would, more often than not, prevent me from reaching all the objectives of my courses. ________
3. Adopting new educational strategies to make students active in class would involve extra work that I could not assume. ________
4. Adopting new educational strategies to make students active would involve the risk of having most of my colleagues view my behaviour as strange. ________
5. There are way too many students in my classes with insufficient cognitive capacities to succeed in collegial studies. ________
6. The majority of students have no intrinsic motivation for learning at collegial level; they work mainly for the "grade". ________
7. Since there is a lot of subject matter to be covered in my courses, I do not have much time to plan formative evaluation activities in class. ________
8. The essence of my work as a professor is to clearly present the material to the students so they memorize it correctly and reproduce it accurately during examinations. ________
9. Way too many students are unable to use in my courses, knowledge that they should have acquired in previous program courses and even in high school. ________
10. There are way too many students in my classes for me to think of initiating case studies or in-depth discussions or teamwork. ________

Appendix

Descriptive cards for six educational strategies.

Simulation
Study
Problem solving workshop
Case study
Problem-based learning
Project seminar

Note**: The types of integration normally targeted, the cognitive capacities required and the motivation stimulated by these strategies are described briefly at the end of this appendix (p. 114 to 116).**

Heading	*Simulation*
Description	This activity combines the features of a Case study with those of Role play. The situation in which the members will evolve is defined in great detail as are the roles of each member of the group. Usually, each individual plays a role he would probably play in "real life". Four examples will illustrate this teaching formula: • Students in business administration simulate a corporate selection committee. • A group of students in aeronautics are initiated to flight simulators and experience flying. • Students in nursing / health care simulate taking a blood sample from a plastic mannequin • Students in humanities recreate the Yalta Conference at the time World War II.
Possible goals	To experiment on a professional situation in a laboratory setting, without the dangers found in real life. To experiment using a past situation so as to grasp its particularities. The longer the simulation and the more it involves different in-depth learning, the stronger will be the transfer of knowledge. This formula, twinned with Case study, is an excellent support for a comprehensive assessment
Role of students	To immerse themselves in the situation and evolve through the characters. Improvise on the central theme of their personal role by taking into account the rules of the trade and the evolution of the situation; and, by using the acquired and required procedural and conditional knowledge.
Role of Professor	To carefully prepare all the material necessary for the simulation. To explain the goals and the rules of the simulation before it unfolds. To observe as the simulation unfolds. To provide feedback on the exercise and together with the members, analyze the disciplinarian and technical aspects of the simulation.

Types of integration usually targeted by this educational strategy

1. Assimilation		3. Application	4. Transfer	5. Regulation

Cognitive capacity usually called into play by this educational strategy

1. To pay attention	2. To locate	3. To associate	4. To break down	5. To categorize
	7. To infer	8. To program	9. To organize	

Type of motivation usually stimulated by this educational strategy

1. Freedom	2. Belonging	3. Cohesion	4. Pride	5. Curiosity
6. Clarity	7. Certainty	8. Authenticity	9. Creativity	

Teaching principles usually called into play by this educational strategy

1. To meet the needs of students in the class.
2. To make the learning meaningful to the students.
3. To have the students participate actively.
4. To bring about the emergence of adequate conceptual models of the learning task.
5. To target long lasting learning.
6. To support creativity and the transfer of learning.
7. To respect the learning tempo of students while being attentive to their zones of proximal development.
8. To make use of mediation.

You will find a more elaborate explanation of the teaching strategies in the foreword to the theoretical texts. A brief comparative description of integration types, cognitive capacities and motivation is included. To learn more about these last three subjects, please refer to: **Archambault Guy** (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, 2nd Edition, Les Presses de l'Université Laval, Sainte-Foy.

Heading	*Investigation*
Description	With the help of a questionnaire distributed to several respondents, the classroom group seek answers to questions revolving around a central theme. They process the answers and the investigation process itself.
Possible goals	On the thematic level, to outline a problem. On the procedural level, to master the stages required in a scientific research project. This formula, combined with the project seminar, could be an excellent support tool for a comprehensive program assessment.
Role of students	To determine the theme of the investigation, to adapt the questionnaire or build on it. To assume and carry out the various protocols involved in the investigation. To discuss the results and the process of their investigation.
Role of professor	To prepare the questionnaire alone or in collaboration with the students. To explain the protocol for administering the questionnaire as well as for its compilation, analysis and the final interpretation of the data. To supervise the gathering of data and its compilation. To moderate the discussions on the investigation results, their interpretation and the process used.

Type of integration usually targeted by this educational strategy

1. Assimilation	2. Modeling	3. Application	4. Transfer	5. Regulation

Cognitive capacity usually called into play by this educational strategy

1. To pay attention	2. To locate	3. To associate	4. To break down	5. To categorize
6. To synthesize	7. To infer	8. To program	9. To organize	

Type of motivation usually stimulated by this educational strategy

1. Freedom	2. Belonging	3. Cohesion	4. Pride	5. Curiosity
6. Clarity	7. Certainty	8. Authenticity	9. Creativity	

Teaching principles usually called into play by this educational strategy

1. To meet the needs of students in the class.
2. To make the learning meaningful to the students.
3. To have the students participate actively.
4. To bring about the emergence of adequate conceptual models of the learning task.
5. To target long lasting learning.
6. To support creativity and the transfer of learning.
7. To respect the learning rate of students while being attentive to their zones of proximal development.
8. To make use of mediation.

The foreword to the theoretical texts contains a more elaborate explanation of the teaching practices A brief comparative description of integration types, cognitive capacities and motivation is included. To learn more about these last three subjects, please refer to: **Archambault Guy** (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, 2nd edition, Les Presses de l'Université Laval, Sainte-Foy.

Heading	*Problem solving workshop*
Description	Small groups of students are invited to try and solve a relatively complex problem that requires diversified knowledge. Each group receives a minimum of information at the outset. The members of each team must then process the data available, seek additional information, formulate hypothetical solutions, compare the relative value of the latter and determine which solution is most valid for all members of the team. The problems studied do not require mastery or the acquisition of specialized or new knowledge, but rather the processing of information already in the possession of group members or which is readily accessible. The problems mainly call for the processing of diversified information as well as the personal values and opinions of the group.
Possible goals	To initiate participants to the problem solving process. To support the discovery of a personal heuristic ability within a group context. To develop an interdependent ability for treating factual and personal information. Problem solving situations that require research and the handling of specialized and / or complex knowledge are found in "Case studies" and "Problem-based learning" (PBL) formulas.
Role of students	To solve the problem through consensus among team members. This is reached by processing perceptions, opinions, knowledge and personal values. To exchange thoughts on the process and the practices or occurrences that made it possible to reach, or not reach a consensus.
Role of professor	To introduce the group to the problem and the rules of the game. To set up the observation tools in each group to provide feedback on the functioning of individuals and teams. To moderate a review of the experiment with the whole group. To provide feedback on the performance of each team and link it to functions and stages of the problem solving process.

Type of integration usually targeted by this educational strategy

1. Assimilation		3. Application		

Cognitive capacity usually brought into play by this educational strategy

1. To pay attention	2. To locate	3. To associate	4. To break down	5. To categorize
6. To synthesize	7. To infer			

Type of motivation usually stimulated by this educational strategy

1. Freedom	2. Belonging	3. Cohesion	4. Pride	5. Curiosity
6. Clarity	7. Certainty	8. Authenticity	9. Creativity	

Teaching principles usually called into play by this educational strategy

1. To meet the needs of students in the class.
2. To make the learning meaningful to the students.
3. To have the students participate actively.
4. To bring about the emergence of adequate conceptual models of the subject to be learned.
5. To target long lasting learning.
7. To respect the learning rate of students while being attentive to their zones of proximal development.
8. To make use of mediation.

The foreword to the theoretical texts contains a more elaborate explanation of the teaching strategies. A brief description of the types of integration, intellectual skills and motivation is included. To learn more about these last three subjects, please refer to: **Archambault Guy** (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, 2nd edition, Les Presses de l'Université Laval, Sainte-Foy.

Heading	*Case study*
Description	Students in small groups take an in-depth look at a series of concrete, detailed, real cases that are linked to important problems in their field of study, so as to analyze them and find one or more promising leads to possible solutions.
Possible goals	To put students in context similar to realities of the discipline or technology they will be studying at university and later, in which they will be working. To develop the capacity to make a diagnosis and skills for processing varied information for both problem solving and teamwork. The longer the case study and the greater the use of in-depth learning styles, the stronger will be the transfer of knowledge. This formula, twinned with Simulation can be an excellent support for a comprehensive assessment
Role of students	To analyze each case in-depth. To identify possible solutions. To justify them. To comment on their results, the analysis process and the functioning of the team.
Role of professor	To prepare each case carefully by incorporating the maximum amount of factual information (historical origin of the case, type of organization where the problem occurs, the persons involved, their functions, their interpersonal relationships, relevant data on the place, the time and the resources, what seems at first glance to be the problem, etc.). To be available to provide explanations on words that could be ambiguous, to clarify the rules of carrying out a case study. To facilitate a review in the classroom of the product and the teamwork process.

Type of integration usually targeted by this educational strategy

1. Assimilation	2. Modeling	3. Application	4. Transfer	5. Regulation

Cognitive capacity usually brought into play by this educational strategy

1. To pay attention	2. To locate	3. To associate	4. To break down	5. To categorize
6. To synthesize	7. To infer			

Type of motivation usually stimulated by this educational strategy

1. Freedom	2. Belonging	3. Cohesion	4. Pride	5. Curiosity
6. Clarity	7. Certainty	8. Authenticity		

Teaching principles called into play by this educational strategy

1. To meet the needs of students in the class.
2. To make the learning meaningful to the students.
3. To have the students participate actively.
4. To bring about the emergence of adequate conceptual models of the subject to be learned.
5. To target long lasting learning.
6. To support creativity and the transfer of learning.
7. To respect the learning rate of students while being attentive to their zones of proximal development.
8. To make use of mediation.

The foreword to the theoretical texts contains a more elaborate explanation of the teaching strategies. A brief description of the types of integration, intellectual skills and motivation is included To learn more about these last three subjects, please refer to: **Archambault Guy** (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, 2nd edition, Les Presses de l'Université Laval, Sainte-Foy.

Heading *Problem-based learning (PBL)*

Description	The students are introduced to a complex problem; the class formulates a number of hypotheses, identifies possible leads and sources of solution after having identified just what the problem really is. In the second week, each individual undertakes his own research to find solutions to the problem. Everyone meets then in groups of three or four, spontaneously created by the professor and the teams are asked to share the results of their research. The professor adds his comments and systematizes the knowledge required to solve the problem in a formal presentation. With a final evaluation on the process they used and the solutions they found, the students tackle another problem.
Possible goals	To outline a problem and master the stages of a research project. To ensure in-depth learning of key concepts. To galvanize the students into action. To initiate them to the problem solving process. To favour personal discovery and invention among the group. To develop an interdependent ability to process information. This method is similar to a problem solving workshop. Two important differences are to be noted: 1. The problems described require research and the discovery of new knowledge to solve them whereas, in the workshop, the students are expected to possess all the knowledge required to solve the problem; 2. Here, the work is individual for the most part, whereas in the workshop it is collective. PBL is used at l'Université de Sherbrooke in medicine and in physics. It is a good lead-in to a project seminar.
Role of students	To solve the problem. To exchange feedback on the process followed and on the phenomena that enabled the solutions to be found.
Role of professor	To present the problem and the resources available to the group. To moderate a review of the experiment with the group. To provide feedback on the proposed solutions and link those to the fundamental knowledge and concepts involved.

Type of integration usually targeted by this educational strategy

1. Assimilation	2. Modeling	3. Application	4. Transfer	5. Regulation

Cognitive capacity usually brought into play by this educational strategy

1. To pay attention	2. To locate	3. To associate	4. To break up	5. To categorize
6. To synthesize	7. To infer	8. To program	9. To organize	

Type of motivation usually stimulated by this educational strategy

1. Freedom	2. Membership	3. Cohesion	4. Pride	5. Curiosity
6. Clarity	7. Certainty	8. Authenticity	9. Creativity	

Teaching principles usually brought into play by this educational strategy

1. To meet the needs of students in the class.
2. To make the learning meaningful to the students.
3. To have the students participate actively.
4. To bring about the emergence of adequate conceptual models of the subject to be learned.
5. To target long lasting learning.
6. To support creativity and the transfer of learning.
7. To respect the learning rate of students while being attentive to their zones of proximal development.
8. To make use of mediation.

The foreword to the theoretical texts contains a more elaborate explanation of the teaching strategies. A brief description of the types of integration, intellectual skills and motivation is included. To learn more about these last three subjects, please refer to: **Archambault Guy** (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, 2nd edition, Les Presses de l'Université Laval, Sainte-Foy.

Heading	*Project seminar*
Description	With the assistance of a moderator, small groups discuss a project presented by a student, before, during and after its realization. The seminar is preceded by a personal exploration to choose the project. It is followed by an exposition if the completed project is suitable for such (painting, sculpture, scientific experiment, etc.). The project can be carried out by teams with a limited number of members.
Possible goals	To deepen one's knowledge of a fundamental concept, discipline or a technique. To establish links between fundamental concepts. To contextualize the key concepts of a discipline or a technique. To ensure integration and in-depth learning of important concepts. To enrich a study or a technical project with feedback from colleagues. This formula, coupled with the programmed workshop, the investigation, the exposition or the laboratory, is an excellent support for a comprehensive assessment The library at cégep de Saint-Félicien abounds in examples of projects carried out by students in Natural Sciences within the framework of a course on integration.
Role of students	To carry out a project and present it in a seminar or, if feasible, in an exposition. To carefully examine the project of other peers and offer feedback based on the course objectives or predetermined criteria.
Role of professor	To assist in the choice of project. To facilitate the exchange of viewpoints. To summarize the viewpoints. To see that feedback is expressed in a descriptive manner (not evaluative) and to facilitate its acceptance by the intended recipient.

Type of integration usually targeted by this educational strategy

1. Assimilation	2. Modeling	3. Application	4. Transfer	5. Regulation

Cognitive capacity usually brought into play by this educational strategy

1. To pay attention	2. To locate	3. To associate	4. To break down	5. To categorize
6. To synthesize	7. To infer	8. To program	9. To organize	

Type of motivation usually stimulated by this educational strategy

1. Freedom	2. Belonging	3. Cohesion	4. Pride	5. Curiosity
6. Clarity	7. Certainty	8. Authenticity	9. Creativity	

Teaching principles usually called into play by this educational strategy

1. To meet the needs of students in the class.
2. To make the learning meaningful to the students.
3. To have the students participate actively.
4. To bring about the emergence of adequate conceptual models of the subject to be learned.
5. To target long lasting learning.
6. To support creativity and the transfer of learning.
7. To respect the learning rate of students while being attentive to their zones of proximal development.
8. To make use of mediation.

The foreword to the theoretical texts contains a more elaborate explanation of the teaching strategies. A brief description of integration types, cognitive capacities and motivation is included. To learn more about these last three subjects, please refer to: **Archambault Guy** (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, 2nd edition, Les Presses de l'Université Laval, Sainte-Foy.

Brief comparative description
Integration types, cognitive capacities and motivation.

Types of integration linked to in-depth learning

Assimilation Form of learning integration based on a progressive engrammation of simple or complex sensations and perceptions, more or less modeled, more or less applied to reality. It ensures the incorporation of the learning into long-term memory.

Modeling Form of learning integration that connects and coordinates knowledge, skills and attitudes into a whole that differs from its parts, to better ensure their incorporation into long-term memory or to restructure learning when new knowledge is added to a field of knowledge already organized as a whole.

Application Form of learning integration that consists in anchoring the model of newly acquired learning by using it in an operation or action on real objects or in a familiar context.

Transfer Form of learning integration that anchors acquired learning into reality by using competencies in new contexts that are interdependent, and achieving this through the **problem solving process**.

Regulation Form of learning integration that anchors acquired knowledge through reflection on the results as well as the process. Taking a step back ensures metacognition, by comparing results to the initial objectives. It also facilitates the regulation of the learning process following an analysis of the progress in the four other forms of integration.

Cognitive capacities required for in-depth learning

To pay attention	Ability to become aware of a specific aspect within magma and to immerse oneself in it simply to acknowledge its existence.
To locate	Ability to thoroughly examine different aspects of a phenomenon, an impression or a fact by devoting attention to each one in a successive manner.
To associate	Ability to link two things together using a cognitive, emotive, objective or subjective criterion.
To break down	Ability to clearly separate the parts from the whole, as per criteria.
To categorize	Ability to distribute a set of items within several groups according to a certain order and based on certain predetermined criteria of resemblance or difference.
To synthesize	Ability to describe a complex whole by summarizing its main characteristics and by sometimes conferring upon it a universal meaning, or a representative and explanatory value.
To infer	Ability to complete a reasoning process by a series of propositions based on premises that are recognized or felt to be true or likely.
To program	Ability to place elements in order, in relation to each other and in a temporal sequence, according to a specific logic.
To organize	Ability to give a systemic form, useful or aesthetic but meaningful and dynamic, to a variety of contents and contexts (or to a set of means, activities and results) that were initially isolated, unrelated or dissimilar.

Types of motivation stimulated by in-depth learning

Freedom	Feeling that the activity is respecting the need for territory in class as well as the individual rate of learning (versus feeling suffocated or pushed around).
Belonging	Feeling that the need to be a part of the group is satisfied by the activity (versus feeling rejected or excluded).
Cohesion	Feeling that the need for solidarity in the pursuit of learning objectives is satisfied by the activity (versus feeling in constant competition).
Pride	Feeling that the need to be recognized is satisfied by the activity (versus feeling shame).
Curiosity	Feeling that the desire to know is alive and pleasantly intrigued by the activity (versus feeling bored).
Clarity	Feeling that the need to understand is satisfied by the activity (versus feeling confusion).
Certainty	Feeling that the need to anchor the learning is satisfied by the activity (versus feeling doubt).
Authenticity	Feeling that the need for individual expression (oral, written, graphic, staged, artistic and technical) is satisfied by the activity (versus the feeling of conformity).
Creativity	Feeling that the need for transcendence is satisfied by the activity (versus the feeling of banality).

Section III

Theoretical texts
in support of
learning activities designed
to sensitize the academic environment
to new educational strategies

Foreword

Historical, practical and theoretical foundations of NES

New educational strategies have been around for one hundred years

In this section we will examine how the NES differ from traditional education. We will then look at the practical and theoretical foundations of NES after having reviewed certain elements of their history. Finally we will describe the commonalities among various NES and propose eight action principles for the creation of effective teaching activities.

1. How the NES differ from traditional education

The most astonishing thing about NES is their age. They are a century old. Their youthfulness is due to their comparison with the traditional approach in education which is a thousand years old. The traditional approach is easy enough to summarize. This is the definition given by **Francoise Raynal** and **Alain Rieunier** (1997) on page 277 of the dictionary of key concepts in education:

> «***Traditional education: An expression for the least ambiguous, since it does not refer to any teaching model in particular... It appears nonetheless that traditional education presents the following essential characteristics:***
>
> - ***Acceptance without much clarification of the relationship of authority between instructor and trainee,***
> - ***Acceptance of school results that follow approximately the Gauss distribution curve,***
> - ***Acceptance of the principle according to which: "The teacher's role is to dispense knowledge, it is up to the student to organize himself/herself as best as possible to optimize learning."***

Ulric Aylwin offers a definition of the traditional approach in an article entitled "Transformera-t-on enfin la pédagogie?" in the May 1996 edition of *Pédagogie collégiale*, vol. 9, no 4, p. 16-20:

"*Traditional education rests on a completely false premise, whereby we take for granted that knowledge exists outside the brain and that education consists of presenting this knowledge to the brain of the student (resulting in the emphasis on teaching), that this knowledge must be stored in the student's memory (resulting in the emphasis on memorization) and, finally, that this knowledge will re-emerge from the memory storehouse, intact, at the opportune moment. What is astonishing here is not that this teaching tradition is based on such a simplistic concept of the brain or such a mechanistic notion of learning. What astonishes is that professors have always recognized the failure of this strategy – since they complain unceasingly that knowledge cleverly presented to the student and apparently memorized by the latter, cannot be found when the time comes to use it (or remains only as corrupted fragments) - and that, despite this constant, they continue to try to transfer specific knowledge to the brain of the student. In addition, professors remain indignant over the fact that "*students did not learn anything in the previous courses" *and continue to get discouraged when they can't help but notice that when it comes time to put their knowledge into practice, students* "appear to have learned nothing at all in their theoretical courses".

It is not surprising therefore that successive generations of professors have continued to repeat, for centuries now, the same didactic model, that of the professor-orchestrator. In the current education given to future professors, this model is rarely examined critically or called into question and when it is called into question, the replacement model is (unconsciously) generally taught through lectures, i.e. in a completely inadequate manner that reinforces the model being discredited.

To bring about the desired changes, we must have the professor embark on a series of learning activities in which he will become aware, on his own, of the inefficiency of any action that attempts to directly cause the acquisition of knowledge in another person; and consequently, of the need to focus entirely on helping the student organize knowledge by and for himself.

*To enable professors to break out of this vicious circle in which they stubbornly continue to use an ineffective educational system (the error of doing "*more of the same" *denounced by Paul Watzlawick), it will be necessary, as stated, to help them see that for the brain, no reality exists apart from its perception of this reality, and that a brain only possesses and knows what it has created or* *reproduced. This reproduction is based on what the brain already knows, on already constructed models of interpretation and on the unique relationship it has with any information it receives, all of which occurs at the very moment the interaction takes place."*

Madelaine St-Jean (1994) clarifies the traditional approach even more explicitly by comparing it to a new education strategy in *L'apprentissage par problèmes dans l'enseignement supérieur* published by le Service d'aide à l'enseignement of l'Université de Montréal.

"The traditional teaching approach is centered above all on knowledge - facts, concepts, theories, rules, procedures, skills. In vocational education, the traditional approach rests, as Schon (1987) observes, on a rational/technological vision. We have the objective know-how and knowledge to face specific situations and solve precise problems. This knowledge comes from scientific research; it deals with consensual, cumulative and convergent knowledge, and with techniques which can be described, tested and recreated. It is possible to transmit them in a rigid manner so that the expert may face and adequately respond to well-defined problems. Vocational education thus designed, is primarily technological.

Since the problems occurring in practice are well known, the teaching environment, while preparing the student in a rigorous manner, can still remain isolated from the workplace environment. To train an expert is to give someone a sum of knowledge that is specific to a given field. Expertise is then judged according to the level of acquired knowledge. With this type of approach, learning consists in memorizing. We postulate that the accumulated and memorized knowledge can be spontaneously generalized and applied later on the practical realities of professional life (Zaïs, 1976).

Knowledge is therefore organized so as to be transmitted effectively. Generally, it is understood that content is structured by subject matter or by discipline, "subject matter represents knowledge in its most logical, parsimonious, useful, real and easy-to-assimilate form".

Every professor is a specialist-expert in a given discipline or subject matter. The expert transmits his knowledge to students who have none; he stands for uncontested authority. That is why traditional teaching methods use lectures, conferences and demonstrations as preferred teaching tools. The professor communicates and acts; the student listens, looks at, reproduces, memorizes and, during the examination, recalls and regurgitates what he has memorized. This is done, more often than not, without any questioning, criticism or actual application of the learned concepts along the way. In this scenario, the student learns passively.

In a traditional teaching approach, students retain little of what they learn and have difficulty putting their knowledge to use. We call this "surface learning" (see, 1988; Bok, 1989; Bridges, 1992). Several authors (Meyer and Jones, 1993 and 1985; Schmidt, 1983; Albanese and Mitchell, 1993) refer to a number of studies that demonstrate this. These studies conclude that:

- *students are mentally absent 40% of the time during class;*
- *their attention span decreases as the course unfolds;*
- *their rate of retention is 70% during the first ten minutes of a presentation and only 20% during the ten last minutes;*
- *their retention is low over time:: after a period of four months, students who took an introduction to psychology course retained only 8% more knowledge than the control group who did not take the course;*
- *in all professional fields, students have knowledge which they do not succeed in using or putting into practice.*

These studies reveal that the traditional curriculum encourages short-term study for the purpose of passing the exam, whereas the PBL (problem based learning) curriculum enables students to understand in greater depth and motivates them to learn. According to the studies of Moore and his colleagues (1990), in a PBL curriculum, students engage less in memorization and more in conceptualization as a learning method. Studies by Clark (1986) show that, in a PBL environment, students seek meaning rather than the reproduction of what they have been taught. The traditional orientation is described as "*surface learning*", whose main features are: the importance given to memorization, a dependency on the professor for task definition and acute performance anxiety. Conversely, an orientation that focuses on meaning supports *"in-depth learning":* the only type of learning that allows for understanding. It is characterized by active questioning and an interest in the connections between ideas and learning for the simple pleasure of learning (see 1988)."

As Madelaine St-Jean puts it, the advocates of NES (PBL, Case method, Simulation, Project, etc) target long-term, in-depth learning rather than the simple accomplishment of passing an exam. Their idea is to develop every student's potential and make him more autonomous by teaching him **all** there is to know, **not only** what is needed to succeed.

2. Successful experiments gave rise to NES

The brief history of NES clearly shows that each one was created and developed as a reaction to the inefficiency of the traditional approach. One constant in the history of NES is that they were shaped by the success of students who had been at risk, students who had experienced difficulties and dropouts who had previously always failed in a traditional approach.

The idea that learning was related to the very nature of human beings is the result of experimental field work. A few key examples of the success of NES are provided below. Every originator of a NES was reacting to the failure of the traditional approach with *high risk students,* by creating an approach that provided convincing results not only with those at risk but also with *normal* students.

Maria Montessori (1870-1952), an Italian physician, succeeded in rehabilitating "defective" children considered "uneducable', by engaging all of their senses. She adapted her methods to normal children and obtained extraordinary results. Many educational toy manufacturers adhere to the teachings of Maria Montessori and the educational principles she established subsequent to her experimentation in the field.

Ovide Decroly (1871-1932), a Belgian physician, followed in the footsteps of Maria Montessori by opening a school for abnormal children and making the child's activity the very essence of his method. He subsequently established a school for normal children and again, met with extraordinary results. **John Dewey** (1859-1952), an American philosopher and psychologist, founded a school based on "*learning by doing*"; and the learning strategy *Project* was born: learning through action and by doing.

Édouard Claparède (1873-1940), a Swiss physician, disciple of Dewey and Decroly, formulated the principle that teaching must be based on the child's level of interest and he placed pedagogical games at the heart of his teaching approach. **Célestin Freinet** (1896-1966), a French educator, founded the Modern School movement, characterized by a cooperative approach where the student learns by doing and is supervised individually based on his own rate of learning[1].

Benjamin Bloom, an American measurement and evaluation expert, demonstrated the effectiveness of mediation and formative evaluations when the student's individual learning rate is respected in *The 2 sigmas problem* (1984). In this study, three groups of students were compared. In the first group, each student was followed individually. In the second group, formative evaluations and some summative evaluations were used. In the third group, the lecture predominated with several summative evaluations. For the final summative evaluation - the same evaluation was used for all three groups - 90% of the students in the first group scored above average, 70% of the students in the second group scored above average and only 20% of the students of the third group scored above average. As a result of this research, *Mastery Learning*[2] really took hold.

3. A teaching concept born of a reflection on experimentation

Jean Piaget (1896-1980), Swiss biologist and psychologist, kept abreast of all the teaching experiments of his time and was a strong researcher in his own right. He is the best known biological theoretician of human cognitive development. He is also

[1]Refer to theoretical text 8 of J. Belleau for a description of this approach.
[2]Refer to theoretical text 9 for a description of this approach.

the father of constructivism: for him, the *transfer of knowledge* by someone who *has knowledge* to someone who *does not* is a myth without any scientific basis. In light of experiments in the field and his own research, he states that knowledge is developed by each individual with the assistance, primarily, of physical or cognitive operations that are carried out on external objects. This development takes place when an individual has reached adequate physiological or psychological maturity to act on an object and control his relationship with it.

Moreover, for Piaget, everything about knowledge seems to be action-related: not only does knowledge originate from performing an operation on an object, but the result of this action creates a set of action models (rather than knowledge), organized into operational structures which allow the learner to adapt his actions to the situations he encounters in daily life. From this standpoint, the learning process begins whenever an individual senses maladjustment, whenever there is a problem.

Problem-based learning (PBL) originated in part due to the very nature of the learning process. Whenever a child, teenager or adult finds his action unsuited to the environment and he wants to resolve this problem of adaptation, he is automatically in a learning situation.

Lev Seminovitch Vygotski (1896-1934), a Russian semiologist and psychologist, who also stayed abreast of all Western teaching experiments, noted the importance of the interaction between the child and its environment. He stressed in particular the importance of adult mediation in the child's learning and development. This mediation needs to be pro-active and respect the child's rate of maturation. The adult, relative or professor, must wait for the right moment, called the *zone of proximal development* (the zone where a function has reached maturation and wants to be awakened, stimulated and utilized in order to actualize itself), to introduce activities that will enable the child to develop a new capability. The socio-constructivist approach originated to a great extent with Piaget, Vygotski and their followers.

Kurt Koffka (1886-1941) and **Wolfgang Köhler** (1887-1967), two German psychologists, and **Jérôme Bruner**, born in 1915 as well as **Robert Mills Gagné** born in 1916, two American psychologists, are representative of two major movements that contributed enormously to the definition of the learning process.

The first movement, the German Gestalt theory, was instrumental in outlining the importance of repetition to anchor implanted long-lasting "*mnestic*" traces in the brain. Just as a scar requires a certain healing time to disengage from the flesh where it is anchored, memory is also a permanent trace, a "*good*" living scar that requires a certain amount of time to become anchored in the neuronal tissue of the brain. The concepts of *anchoring* and *disengagement* typical of the neurolinguistic approach, originate in part with the Gestaltists.

The Gestaltists also contributed two key findings that help explain how the neuronal tissue keeps a permanent trace of learning. The first finding shows the importance of the contrasting and simultaneous presence of both background (context) and gestalt (form) for the creation of learning models in the brain. A white gestalt on a white background is invisible. Inversely, the contrast between the gestalt and the background, between the object and its context as well as the use of varied teaching formulas all help to anchor learning.

The second contribution of the Gestaltists consists in reminding us just how much learning is indissolubly linked to the biological changes in the neural networks. Learning very often requires a time of incubation and impregnation, sheltered from consciousness, to emerge in unexpected bursts, through *insights*. Learning is not a peaceful river of studies programmed by a school administrator, but a series of cascades fed by numerous secret and hidden streams, interspersed with still waters populated by expansive flora and fauna that remain largely unknown to our consciousness.

The cognitive approach, as represented by Bruner and Gagné, contributed to NES by outlining the cognitive processing of information by the learner. The processing of this data always leads to a model of reality, a model created by the learner based on his needs, objectives, intentions and preconceived ideas.

The model can be a simple automatic or mechanical reaction, a spontaneous 'snapshot' produced by a high-performance neural network. But it can also be a construct, a hard won product that results from more or less complex cognitive operations on various types of subjective information: sensations, perceptions, emotions, feelings, clichés, stereotypes, images, symbols, thought associations, categories, metaphors, comparisons, memories, etc. All of these make up information that has to be processed in order to produce new learning. In certain types of cognition, data processing often resembles a long and complex process of problem solving.

4. **Synthesis**

A synthesis would be appropriate here; a synthesis rather than a summary because a synthesis tries to reconcile divergent viewpoints. Let us try to synthesize in five points what previous experts and theoreticians discovered in scattered and sometimes controversial or contradictory ways about human learning.

1. There can be no long-term learning if we do not respect the biological and psychological nature of learning or the specific rate of maturation of each learner.

2. There can be no long-term learning if there is no action by the student on the learning task.

3. There can be no long-term learning if the student is not interested in the learning task.

4. There can be no learning if the student does not have a good cognitive representation of the learning task, a good representation of the action he must carry out on the object and a good representation of his interest in carrying out this action.

5. Human learning is more effective and accelerated if the student is accompanied by a peer (child or adult) who can, at the opportune time, provide a good example and mediate.

As a whole, modern researchers have ratified their predecessors' discoveries on the learning process, thanks to technological advances and access to the brain's black box, They seem to conclude that given the functioning of the brain, learning on the biological and psychologically planes relies on the interaction of three dynamic systems: a model system, a motivation system and an action system.

For modern neurobiologists, knowledge and learning is not the mere recording of data. The subject always intervenes actively in the **construction** of knowledge, as underlined by Daniel Schacter: *"Our memory does not just take snapshots of the world. It does not record passively what occurs. On the contrary, it functions in a constructive way by using fragments of learning which it already possesses to connect various elements of the world to our needs and objectives*[3]."

Modern researchers also seem to conclude that, physiologically, cognitive representation is a result of action and depends on motivation. According to their research, "*on a strictly chemical-electrical level (of the brain), it is probably impossible to have learning models without prior motivation*."

Ancient and modern men of science are creating quite an upheaval in the traditional approach where the key element is knowledge! The learning hierarchy has been reversed: knowledge to act, know-how, and personal conduct now takes precedence, both emotionally and motivationally, over the world of cognitive models. Whether declaratory, procedural or conditional, knowledge remains a model dependent on the action and motivation of the learner. Knowledge and cognitive models are not ends unto themselves, nor are they the starting point of learning. The real starting point is motivation, the final point is action. A learning model is an intermediary tool that allows for the actualization of the objective.

As regards the brain, modern research techniques have confirmed that life precedes knowledge, biologically, psychologically and ontologically; and life precedes the model we have of it. Learning is "life" and if it is to be more effective, it can no

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[3] See Les *secrets de l'intelligence*, CD-Rom Ubi Soft, 1997.

longer revolve around the professor and be content with knowledge. Only the reverse is productive: the action of the expert must revolve around the natural learning activity of the student.

5. Principles of pedagogical practice

Can we extract any pedagogical principles from the sum of studies done on the learning process? Can we extract a few simple principles? The answer is yes. Let us begin by organizing these principles around the following eight characteristics.

A relevant educational strategy implements earning activities that have the following eight characteristics:

A- They meet the needs of the students in the classroom;
B- They make the learning tasks meaningful to the students;
C- They galvanize the students into action;
D- They bring about the emergence of adequate models of the learning task;
E- They target long-lasting learning (in-depth, long-term);
F- They support creativity and the transfer of learning;
G- They respect the learning rate of the students;
H- They resort to mediation.

A- The learning activity meets the needs of students.

1. It creates conditions whereby individual students feel secure and appreciated in the classroom and at college.
2. It is a process that stimulates curiosity and generates interest.
3. It provides answers and solutions to problems that preoccupy students.

4. It calls upon the spontaneous, natural expression of students and constructs learning based on this raw data.

B- The activity gives meaning to the learning task.

5. It introduces the learning task as a whole, with a global meaning that is greater than the sum of its parts. It is this totality, the complete picture that gives meaning to each part (a clock is not just a juxtaposition of springs, hands, screws, etc.).

6. It always introduces a composite subject, connecting the parts to each other and within the whole, in several ways. These relationships explore the similarities, differences, cause and effect, the temporal and spatial sequence, the functions, etc.

7. The activity gives the student power over the learning task. It displays the results of learning, i.e., knowing how to do and knowing how to act, with knowledge that is based on:

- Learning models already created by individual students (declarative, procedural and conditional knowledge);
- The real nature of the student, who he is, who he wants to be or can be at that moment (emotions, feelings, desires, motivations, attitudes, etc.);
- What the student wants to experience or is able to experience with others in the classroom, what he wishes to share with them, taking into account the academic environment (traditions, languages, conventions, rules, roles, pre-established interpersonal relationships, formal and abstract networks, etc.).

C- The learning activity galvanizes the students into action.

8. It creates activity on the biological level. All senses are brought into play. Visual, auditory, olfactory, gustatory and tactile sensations are regularly brought into play to comprehend the learning task. The student often has the opportunity to move around in the classroom, occupy different spatial positions, express himself emphatically, with mimicry and gestures, etc.

9. It involves the students psychologically. Attention is more than a passive receptor. A relevant activity calls upon all aspects of creative attention; it leads to a state of relaxation, focused on the essence, a state close to contemplation and meditation. It also brings about an immersion in the learning task or in the sensory impact it provokes. The activity brings movement to attention, causing the student to actively explore the learning task, its parts and inter-relationships; and, to move smoothly between relaxation, immersion and exploration.

   The activity can also bring the attention to take a reflective step back and examine the road traveled, to study the best way to proceed and how best to face the unknown. This distancing from the learning task can result in the attention becoming itself the learning task. Creative attention strongly contributes to the anchoring of learning.

D- The learning activity brings about the emergence of adequate models.

10. The activity (by way of contrasts and cognitive dissonance, through contextualization, a variety of teaching formulas, through comparisons, examples and metaphors, the use of a conventional language that is precise and accessible) brings about the emergence of a clear learning model and the action needed to master it.

11. The activity, through questions, reformulations, reflections, confrontations and syntheses (that reconcile opposites and contradictions), gives the student an

accurate model of the value of the learning task, independent of the value the student attributes to it.

E- The activity targets long-lasting learning (in-depth and long-term).

12. The learning activity anchors new knowledge in the familiar ground of what is already known. Its starting point always consists in bringing to conscious awareness what is already known or mastered in connection with the learning task, and amalgamating it to the new learning or discoveries. To this end, it uses various spatial and temporal re-modeling processes (diagrams, charts, accounts, journals, portfolios, etc.) and various application procedures within familiar contexts of the newly-acquired skills (games, exercises, solving well-defined problems, case studies, etc.).

    The learning activity also respects the limitations of engrammation into neuronal networks: human attention requires a minimum of 20 to 30 minutes to integrate five to seven new elements. If these elements are complex or have no antecedents in the memory of the learner, the time required can be considerably longer.

13. The activity develops the capacity of the *"brain"* to create new networks within neuronal tissue and new synaptic electrochemical *patterns* through the use of various cognition-building exercises (various forms of repetition, change of rhythm in a known routine, change of context, increased complexity of a task, corrective evaluation, progressive inclusion of tasks, etc.).

F- The activity supports creativity and the transfer of learning.

14. The learning activity enables the student to transfer his acquired learning to new and complex situations by teaching him how to make visible what is invisible and to make present what is absent. It uses creative imagination, divergent thought and the resolution of concrete, real and *poorly defined* problems in a recurring fashion. It thus facilitates the development of independence.

G- <u>The activity respects the learning rate of the students.</u>

15. The activity makes it possible to identify the students' zones of proximal development and enables the professor to intervene at those times in an appropriate manner, i.e., when the ability to act faces a difficult challenge, and the student's learning model is ready for a mutation. To facilitate learning in slower students, the activity allows for an intervention when students can detect and establish zones of proximal development, namely students who "*just recently*" understood or mastered the learning task and also understand how they succeeded in doing this.

H- <u>The learning activity resorts to mediation.</u>

16. The learning activity regularly leads the student to interact with his peers and with the professor (and adults who play a significant role in his development). It creates situations which favour learning by example, where the leitmotiv of the professor (or the assisting peer) is "s*ee how I do it*" rather than "*listen to what I say*". To accelerate learning, the activity encourages the students to coach each other and leads the professor to coach the student along the way and to intervene appropriately at the opportune time.

Text 1

New educational strategies versus the traditional method: What are the differences?

Scientific discoveries on the functioning of the brain and the learning process!

Ulric Aylwin, pedagogical development coordinator at Cégep de Maisonneuve in 1992, responds to the above question in *La pédagogie différenciée fait son entrée au collège.* The text reproduced here is taken from volume 5, No 3 of *Pédagogie collégiale*, which appeared in the March 1992 edition (pages 30-37). Before proceeding however, let us hear what **Jean Piaget** had to say in 1969 in a chapter of his book *Science of Education and the Psychology of the child* in the chapter entitled *The new methods: Their psychological foundations.*

"… the active methods are much more difficult to employ than our current receptive methods. In the first place, they require a much more varied and much more concentrated kind of work from the teacher, whereas giving lessons is much less tiring …

… Secondly, and above all, an active pedagogy presupposes a much more advanced kind of learning, and without an adequate knowledge of child psychology (and also, where mathematics and physics are concerned, without a fairly good knowledge of contemporary developments in those disciplines), the teacher cannot properly understand the students' spontaneous behaviours, and therefore fails to take advantage of reactions that appear to him quite insignificant and a mere waste of time. The heartbreaking difficulty in pedagogy is in fact, that the best methods are also the most difficult ones: it would be impossible to employ a Socratic method without having first acquired some of Socrates' qualities, the first of which would have to be a certain respect for intelligence in the process of development.

… The new methods are those that take account of the child's own peculiar nature and make their appeal to the laws of the individual's psychological constitution and those of his development. The criterion upon which a distinction between the two kinds of education is to be based should therefore be sought, not in the use made of any particular feature of the child's mentality, but in the general conception that the educator forms of the child in each case.. …

… From such a point of view even the most individual kinds of task performed by students (writing an essay, making a translation, solving a problem) partake less of the genuine activity of spontaneous and individual research than of the imposed exercise or the act of copying an external model; the student's inmost morality remains fundamentally directed toward obedience rather than autonomy. Whereas, on the other hand, to the degree in which childhood is thought of as endowed with its own genuine form of activity, and the development of mind as being included within that activity's dynamic, the relation between the subjects to be educated and society becomes reciprocal: the child no longer tends to approach the state of adulthood by receiving reason and the rules of right action ready-made, but by achieving them with his own effort and personal experience; in return, society expects more of its new generations than mere imitation: it expects enrichment."

Differentiated instruction makes its entry in colleges

Ulric Aylwin

In the classroom, student diversity assumes many forms: levels of intellectual development, learning styles, culture, age, degrees of motivation, etc. The teacher can, to a certain extent, respect this diversity by varying a number of elements: the way information is dispensed, the cognitive capacities required of the students, the content, the exercises and the teaching strategies.

The term "differentiated instruction", adopted officially in France in 1979[4] refers to a pedagogical organization destined from the start, to allow professors and students at high-school level to overcome problems resulting from a return to *mainstreaming*, as opposed to the previous academic classification system where students were oriented toward a "reduced", "full" or "enriched" curriculum.

Differentiated instruction as seen in the French model focuses on diagnosing the competency level of each student, in each subject matter. With this information, sub-groups are formed which can take advantage of a "different" style of learning, based on their identified needs.

The four principal works on this subject are those of Louis Legrand[5], Philippe Meirieu[6], Sylvie Mersh-Van Turenhoudt[7] and Halina Przesmycki[8].

There will be no references to these works in this section because the difficulties we are beginning to encounter in our colleges differ from those encountered in the French college system. For instance, the differentiation strategy recommended by the four French authors only stresses certain aspects of group heterogeneity. Also, the proposed pedagogical organization is not compatible with the existing administrative framework of our cégeps.

On the other hand, our colleges are now facing the same widespread phenomenon that permeates our secondary levels, that is, vast differences within student groups. Differences that are forcing an ever-increasing number of teachers to try and "differentiate the teaching" they dispense.

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[4]Françoise CROS, researcher with the I.N.R.P., new text quoted on page 42 in: LORIMIER, Jacques, *Des stratégies pour la qualité de l'éducation en France: réformes de système et pédagogie différenciée*, Québec, Conseil supérieur de l'éducation, 1987.

[5]LEGRAND, Louis, *La différenciation pédagogique*, Paris, Éditions of Scarabée, 1986.

[6]MEIRIEU, Philippe, *L'école, mode d'emploi. Des méthodes actives à la pédagogie différenciée*, Paris, ESF Editor, 1985.

[7]Mersh-van TURENHOUDT, Sylvie, *Gérer une pédagogie différenciée*, Paris, De Boeck, 1989.

[8]PRZESMYCKI, Halina, *Pédagogie différenciée*, Paris, Hatchet, 1991.

THE CONCEPT OF DIFFERENTIATED INSTRUCTION

The expression "differentiated instruction" is relatively new. It was originally popularized by Louis Legrand and then by Philippe Meirieu, to emphasize the need to take into account the many "differences" between students.

We can use the more traditional wording of "personalized instruction"[9], but there is good reason to stress the "differences" that exist not only among individuals, but also among sub-groups.

What is personalized or differentiated instruction?

"The personalization of instruction" is the creation of conditions that maximize the odds that each student will master the learning objectives, because they take into account his prior knowledge and enable him to arrange a good part of his learning activities in space and time, to proceed freely at his own pace and to easily receive an abundance of feedback (both quantitative and qualitative) which is useful for him[10]."

"The differentiation of instruction is a diagnostic and adaptation activity that takes into account the reality and diversity of its public[11]."

"Differentiation [is] the fact that, at a given moment in a classroom, students engage in diverse activities that are precisely customized for each one and correspond to their resources and needs… [12]."

Differentiated instruction was officially defined in 1979 as that form of education which, "while working with the same total number of students in the classroom, forces the teacher to vary the vocabulary he uses, the methods he employs as well as the nature and difficulty of the exercises presented to the students[13]."

In short, differentiated instruction offers simultaneous learning activities that vary according to the differences present in the group.

A VARIETY OF DIFFERENCES

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[9] In the United States *Personalized System of Instruction* (PSI) was popularized especially by F. S. Keller.
[10] BÉGIN, Y. and G DUSSAULT, quoted in R. LEGENDRE, *Dictionnaire actuel de l'éducation*.
[11] LEGRAND, L, *Op cit.*, pages 37 and 38.
[12] MEIRIEU, P., *Op.cit.*, page 135.
[13] CROS, F, refer to note 1.

Teachers have always noticed important differences between students; but several factors have recently broadened the range of these differences and accentuated them.

Recent studies on the brain, the nature of intelligence and learning processes have identified a number of hitherto unknown differences.

In addition, the disappearance of groupings by skill levels (reduced, full and enriched) or by vocational guidance channels has saddled teachers with integrated groups that are highly heterogeneous.

Also, the democratization of education has led to classrooms of students from different social groups, with cultural interests and ideals vastly different than those of formerly identified minorities.

Fourthly the return of many adults to school introduces dynamics that can be difficult to manage for the teacher.

Lastly, the increasing number of students from vastly different ethnic groups accentuates the variegated character of the student population.

Let us examine in greater detail the diversity resulting from all these factors.

Gestalt and the levels of cognitive development

Seven multiple intelligences (Gardner)

After numerous observations, psychologist Howard Gardner identified seven multiple intelligences relatively independent from each other, seven categories of cognitive skills and, consequently, of academic interests[14]; they are: logical-mathematical, verbal-linguistic, musical-rhythmic, visual-spatial, bodily-kinaesthetic, interpersonal, and intrapersonal.

Unfortunately, teaching practices currently in use are primarily of the verbal-linguistic and logical-mathematical types, which constitutes an intellectual handicap and demotivation factor for students more endowed in other forms of intelligence.

[14]GARDNER, Howard, *Frames of Mind*, New York, Basic Books, 1983.

Field dependent (Witkin)

Herman A. Witkin and his collaborators[15] have shown that students are divided, relatively speaking, between two modes of perception of reality: those who are influenced by the stimuli of the situation (field dependent), and those who retain only the information or environmental stimuli that are relevant to what they consider to be the goal of the study or the work (field independent). Consequently, a teacher needs to be more explicit for "field dependents" as to objectives and limitations, while allowing greater freedom to roam, so to speak, to those who are "field independent".

Cognitive development stages (Piaget)

Among the various stages involved in the development of intelligence, the concrete-operational and formal-operational stages are crucial for collegial studies. However, it has been shown that student development varies on these points, i.e. they can be at the concrete stage in a given field and at the formal stage in another, hence the need for education which works on both levels.

Cognitive structures (J. Bruner)

Jérôme Bruner[16], one of the founders of cognitive psychology, brought to light the knowledge that during the first months of life, a child is constantly seeking to understand the world around him, by building models, forms and categories so he can interpret the realities he encounters.

When a student arrives at school or college, he has already constructed tens of thousands of "interpretative models" exclusive to him. All the more reason to implement an academic system that will enable each student to access his own explanatory models! This type of education is characterized by the fact that each student will be able, in most cases, to access knowledge in his own way.

Learning styles

The distinction between forms of intelligence and learning styles may be debatable, but considering the abundance of theories and models in this field, we will cover this subject separately.

The four learning styles of Kolb

David Kolb created a model that breaks down the "learning cycle" into four stages:

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[15] WITKIN, Herman A., "Field-dependent and Field-independent Cognitive Style and Their Educational Implications," *Review of Educational Research* n° 4, Winter 1977

[16] BART, Britt-Maria, « Jérôme Bruner et l'innovation pédagogique», in *Communication et langages*, n° 66, 1985, pages 46-58.

Concrete Experience, Reflective Observation, Abstract Conceptualization and Active Experimentation.

Kolb noted that individuals find it easier or have a propensity to invest in one stage or another of this learning cycle, which led him to identify four learning styles[17].

The *diverging style* lies somewhere between the experiential and reflection stages; this person likes concrete situations and many different viewpoints; this person prefers to watch rather than do.

On the opposite side is the *converging style* that combines conceptualization and experimentation; this person seeks concrete application of theories and is gifted at problem solving.

The *assimilating style* combines thinking and conceptualization; this person is skilful at developing abstract concepts and excels at synthesizing highly diversified information; this person is keener on cognitive activity than on social interaction.

Finally, the *accommodating style* combines experimentation and concrete experience. This is a hands-on person who wants to be part of the action and who is able to rely on information and assistance provided by others.

The sixteen types of Briggs Myers

Isabel Briggs Myers identified eight tendencies or cognitive preferences for processing data: extraversion or introversion; sensing or intuition; thinking or feeling; judging or perceiving.

By combining these eight dominants, Briggs Myers defined sixteen psychological types[18].

For example, type ISTJ (introversion, sensing, thinking, judging) is serious, calm, concentrated and applies himself. He is practical, methodical, logical, realistic and reliable. He is very different from type ESFJ (extraversion, sensing, feeling, judging) who is warm-hearted, loquacious, well-liked, a born collaborator, committee member and eager to serve, not very interested in abstraction and technical details.

From these examples we can see the complexity arising from sixteen different types of students. It creates the necessity, on one hand, to successively vary teaching approaches to support the various types of learning and, on the other, to allow the student to master the

[17] KOLB, David A, *Learning-Style Inventory*, Boston, McBer and Co, 1981 and 1985, 13 p. GAUTHIER, Lucie and Norman POULIN, *Learning to learn*, Sherbrooke, Éditions de l'Université de Sherbrooke, 1983, chapter 1: " Le procédé personnel d'apprentissage ", pages 13-56.

[18] BRIGGS MYERS, Isabel, *Introduction to Type*, Palo Alto, Consulting Psychologists Press Inc, 1962, Tenth printing, 1986.

learning process as much as possible on his own by allowing him to study according to his own style.

Auditory, visual and kinaesthetic personalities

The distinctiveness of the Auditory-Visual personality was demonstrated by Doctor Lafontaine[19]; and again by Garanderie[20]; it is also mentioned, in a different form, by the founders of neurolinguistic programming who identified the body-kinaesthetic dimension[21].

Culture

Let us first distinguish between two cultural types: ethnic groups and social groups.

Ethnic differences are obvious. It is important however, to note the rapid growth in the number of students coming from increasingly varied cultural minorities.

The expression “social cultures” encompasses the differences in cultural references among students from very different physical, financial, cultural, social, and professional environments.

Age

The school population is evolving rapidly; in certain technical programs, more than half of the students are adults who come from the labour market with expectations and experiences that are very different from students fresh out of high-school.

Other individual traits

Preparation

Prior knowledge and competencies vary from one student to the other.

- From a quantitative standpoint: depending on the school of thought or on the professors who taught the preceding courses, the range of knowledge can vary significantly.

- From a qualitative standpoint, students are distributed over a long continuum that

[19] MEUNIER-TARDIF, Ghislaine, *Le Principe de Lafontaine*, Montréal, Libre Expression, 1979. Translation by Edward Baxter "Eye People, Ear People" Toronto: NC Press 1989, Non-fiction –ISBN 1-55021-009-2

[20] LA GARANDERIE, Antoine de, *Les profils pédagogiques*, Paris, Le Centurion, 1981.

[21] BANDLER, R. and J GRINDER, *Frogs into Princes*, Moab, Real People Press, 1979.

ranges from simple memorization and mechanical application of knowledge and formulas to the comprehension of principles and theoretical assimilation.

- From a perspective of cognitive capacity: some students do not know how to study or use reference sources, some read and write with difficulty, whereas others readily acquire the capacity for cognitive work.

Motivation

Certain students are intrinsically motivated. They want to know and assimilate as much material as possible. Others only study if external pressure is applied.

According to students, this is because studies in general and some courses in particular do not relate to their personal values.

Moreover, the professional orientation of each student means that courses do not carry the same weight for all.

In addition, subjective interests differ even among equally motivated students: each will react differently to the subject matter, the work and the methods used.

Learning rate

For all the reasons mentioned above, individual rates of comprehension, memorization, assimilation, problem solving, writing and more, will vary considerably from one student to the other.

The preceding information clearly shows that differences between students are numerous and profound. We will see how a professor can take up the challenge of creating learning situations that will allow all these differences to co-exist and thrive within the same group of students.

OVERVIEW OF DIFFERENTIATED INSTRUCTION

Differentiation can take various forms; we have identified four pairs.

Simultaneous or successive

Differentiation is **simultaneous** when different exercises are given at the same time to various sub-groups, according to their interests, competencies and learning rate. Some may be working on case studies, others responding to questions about a text, or comparing and correcting their respective tests, endeavouring to solve a problem, etc. It can also be simultaneous when the professor uses different media: speech, transparencies, texts, objects; or, when students perform several tasks at once: reading, discussion or writing in sub-groups, which call upon a variety of cognitive capacities.

Differentiation is **successive** when variety is present at each stage: lecture, then individual exercises, then discussions in sub-groups, then plenary sessions, then tests, then homework, etc.; or, in the sequence of cognitive capacities: definitions, case studies, applications, problem solving, etc.; or, in other variations spread out over a given period of time.

Simultaneous differentiation is obviously more difficult to realize but it is the form of differentiation that respects most closely, in a continuous way, all the individual disparities present.

Collective or individual

When all students are subjected to the same form of differentiation, it is said to be collective, as in the case of media used by the professor in front of the entire group, or identical tasks required from all the students, or the same stages for all, etc. On the other hand, when each sub-group or student has its own objectives, content, exercises, form of expression, allotted time and more, differentiation is said to be **individual**.

It goes without saying that individual differentiation takes personal characteristics into account more so than collective differentiation.

In the classroom or outside the classroom

Differentiation **in the classroom** requires complex organization since it is necessary to manage a variety of activities taking place at the same time, in the same place and lasting the same amount of time.

Differentiation **outside the classroom** takes place simultaneously but in several locations (library, laboratories, workrooms, classrooms, etc.) or at different locations and times other than regular classroom hours. This differentiation is easier to manage since each student or sub-group is responsible for their own work.

Minimum or maximum

Differentiation is said to be **minimum** when it limits itself to offering collectively, in the classroom, a variety of means of information, styles of interaction, intellectual operations, learning approaches and exercises.

Maximum differentiation offers each student the choice of *teaching strategy* (course, tutoring, teamwork…), *content* (based on choices offered), *rate of study* (within the trimester), *form of evaluation and production* (based on conventions), and so on.

For example, we could say that a professor, who presents the course contents to students using a variety of media, encourages the students to use their cognitive capacities and varies the aspect of the subject matter, is practicing a collective and simultaneous differentiated instruction in class but at a minimal level.

On the other hand, a professor who offers a choice of tutoring or teamwork outside the classroom or meetings in the classroom, the choice of five subjects among a list of fifteen, a choice between three kinds of final productions, and the choice of the duration of the learning… could be said to be practicing maximum differentiation.

THE NATURE OF DIFFERENTIATED INSTRUCTION

No professor, regardless of how skilful or experienced he may be, can take into account all the differences among all his students if he is the person who carries out most of the cognitive activities in the classroom.

As shown above, the quantity and depth of differences between students is such that any academic organization centered on the professor can only offer differentiated instruction on a very minimal level. Thus, it is important to transfer this responsibility to the student, by allowing him to assume responsibility for the stages and aspects of his own acquisition of knowledge. Each individual thinks and learns in a unique way that respects his own natural form of intelligence, cognitive style and learning rate as well as all other characteristics exclusive to his personality.

In concrete terms, this means it is necessary to transform the current schooling environment where the professor is responsible for 90 percent of the preparatory work, presentations, content management and evaluations, into an organization where 90 percent of all these operations will be assumed by the individual student. There is a simple criterion to use for measuring this: every teacher knows from experience that knowledge they thought they had acquired as a student often had to be re-learned when it was needed for teaching. This criterion consists simply in verifying that the student can accomplish for himself or his peers, the tasks or cognitive activities of the teacher.

POSSIBILITIES OF DIFFERENTIATED INSTRUCTION

How can we differentiate instruction? What aspects can we vary? There are a number of opportunities or sources of variation. We have listed several below. It will be up to the professor to combine these elements into various strategies to achieve a concrete differentiation.

Groupings

The students can work in various configurations: together, in plenary sessions; or the class can be divided into two groups or various sub-groups based on group makeup: strong and weak, male/female, younger students and adults, ethnically diverse and homogeneous; sub-groups can vary in size: 5, 4, 3 or 2 persons; or students can work individually.

This aspect of grouping may seem commonplace or even irrelevant as regards differentiation, but this is not so. Cognitive capacities, learning styles, ways of interacting, assimilation rates, levels of responsibility and others vary greatly from one group to another; and allow for the development of very different personal potentials.

Communication means

This subject may also seem commonplace, but again, not so. Different channels used to transmit information are "charged" with cognitive significance and cultural experiences that differ greatly: the spoken word (of the professor, peers, lecturers or various guests); texts; the blackboard or hard copies; transparencies; slides; audio tapes; videotapes; films; course materials; objects, various apparatus and models. Different means of communication call upon different habits, abilities and intellectual resources.

Actions

Any activity undertaken by students offers them an opportunity to put their own resources to good use. And, despite the apparent simplicity of these actions, it is important to ensure a variety of them in the classroom.

Actions such as listening, moving around, changing places, looking at, imitating, speaking, drawing, reading, sensing, handling and even tasting objects relate to the dominant behaviours mentioned earlier in the section on learning styles. These actions also touch upon another kind of variation and source of differentiation: cognitive capacities.

Cognitive capacities

The study of the forms of intelligence (as seen above) led us to become aware of the diversity of perception modes and ways of processing data. It is therefore important to create a sufficient number of cognitive activities that will allow students to use their own way of thinking: memorization, recall, observation; to identify, name, describe, define, analyze, compare, classify, summarize, synthesize, schematize, make, demolish, remake, reformulate, transpose, interpret, foresee, extrapolate and finally, imagine the situation as though the goal were reached; and then evaluate, critically assess, create, induce, deduce, conclude, use problem solving, find fields of application, apply and examine the mental process used (metacognition), meditate, and visualize.

The above list can be used as a checklist for assessing to what extent our pedagogical organization either confines itself to certain operations or truly challenges the different facets of intelligence on a regular basis.

Contents

There are two ways to view contents: variation and differentiation.

Variation consists in not having the student's brain focus on the same type of content for too long a period of time. This prevents fatigue and loss of interest, and also avoids addressing for too long the same "type" of learner. We can consider, for instance, the following list of possible contents: Facts and data. Ideas, concepts and terminology. Principles, laws, rules and theories. Approach, method and process. Examples, applications and transpositions. Viewpoints, attitudes and values. Historical and prospective aspects.

By examining current teaching practices based on this list, we see that the tendency, in a two-hour course for instance, is to spend the first hour on facts, concepts and principles; and spend the second hour on examples, applications and transpositions, instead of following a successive spiral approach where all the bases could be covered during the presentation of each idea or concept.

The **differentiation** of contents is another thing entirely: it is the attribution of different contents, in whole or in part, to each sub-group or student based on their objectives, interests and capabilities. This type of differentiation can be done for all the students or only a few, for the entire duration of the course, or a portion of the course content.

Exercises

Identify key words/concepts, write one or more questions dealing with the previous course, on the text..., find the critical incident, write a summary sentence, identify the fundamental concept, define key words/concepts, build a concept pattern, undertake the construction of a concept, identify the question which would have led to such or such an answer, find examples of a law, create exercises for the application of a principle, identify a law or principle, solve problems following such or such an example, separate and reconstruct each description starting from a list where statements relating to two cases are mixed up, do a case study, assemble montages, build and invent situations, case studies, sequences, possibilities, find the missing pieces, the errors or foreign elements, do some brainstorming, identify the ins and outs of a situation, organize a debate, make use of material imagery, have the students prepare questions for an interview with their professor.

Each type of exercise calls upon the intelligence and experience of students in a different manner, hence the importance of varying the activities. The majority of these exercises can be of short duration, a few minutes; or they can extend to more than one hour, be done in the classroom or outside the classroom; they lend themselves well to both oral and written formats; they can used for formative and summative evaluations; and finally, they can be differentiated, in terms of content or requirements, for different sub-groups.

Teaching formulas

This is one of the most important sources of opportunities for differentiation.

As regards teaching formulas, we cannot overemphasize that each one has specific conditions of use and effectiveness. In the absence of these conditions, failure is almost assured and the dissatisfaction of all an inevitable result. Each formula requires specific documentation and the appropriate "student guidebooks".
These teaching formulas are:

The presentation (formal or abstract, with or without media, continuous or in sections)
Questioning (open or closed questions, structuring questions, rhetorical questions)
Teamwork
Tutoring
Modular learning
Programmed instruction
Self-managed learning
Panels
Seminars
Discussions, debates
Games and simulations, role playing
Demonstrations
Laboratories
Training courses
Projects in the work environment
Investigations
Case studies
Research
Individual reading
Logbook
Various written productions

Learning rates

For many, the hardest difference to manage among students is their individual learning rates. This difficulty is experienced on two levels.

First: the unfolding of a lesson.

Let us consider two typical methods: the presentation and work in sub-groups.

One of the disadvantages of the *presentation* is that it attempts to reach students who differ widely in preparation, interest levels, cognitive styles and learning rates in a similar manner,. The solution is to systematically interrupt the presentation, every twelve or fifteen minutes to take an "assimilation-break". These breaks can be used to work on exercises provided beforehand to the student. They also take into account individual learning rates as each individual can regain a firm footing during these periods.

Work in sub-groups is also characterized by an even more noticeable contrast in individual learning rates. The solution is threefold: Initially, limit the duration of the work stages. For example, instead of assigning three questions during a 45-minute period, assign one question for study every 15 minutes so as to be able to frequently assess and reorient the group from a common starting point. Then, plan for additional instruction and guidebooks for sub-groups that are more or less at a disadvantage vis-à-vis the contents. Finally, prepare more difficult or complex questions for the sub-groups who have finished the work more quickly.

Second: during the trimester

The challenge here is to give slow learners with gaps in their knowledge and those who need more time to assimilate, the opportunity to stay "abreast" without slowing down the overall group and making sure that every participant is present at the finish line.

We would like to make two comments relating to the above. First, there are limitations to the gaps in prior knowledge that can be taken into account: students who are too weak should be steered towards the required academic upgrading. Secondly, we cannot guarantee that all will benefit from differentiated learning rates and achieve the minimal course objectives at the finish line.

Having expressed these reservations, here are some ways to take into account the diversity in learning rates.

The initial and ongoing diagnosis

During the first week of courses, it is important for the professor to identify where each student stands in relation to the knowledge and skills required for the course, and that the student himself recognizes this. On the basis of the diagnosis, the professor will offer suggestions and instruction to the student and make his final decisions regarding the organization of the trimester.

Thereafter, at least once a week and usually during the class, the professor should check each student's mastery of the subject matter through the use of formative evaluation. This enables the student to know where to exert his efforts and the professor is able to identify the type of help the student requires.

Self-teaching

Once individual student weaknesses are recognized, it is necessary to be able to offer the students some remedial tools. This implies that the professor has self-teaching tools at his disposal which the student may need in connection with some of the major difficulties he is likely to encounter[22]. These tools can be:

- A study guide. These guidebooks for specific learning gaps guide the student to the documentation he needs, where to find it, the order in which to proceed and how to self-evaluate.
- Course notes on content that needs to be reviewed.
- Various checklists on questions to ask oneself, stages to complete, criteria to respect, etc.

Inter-teaching

It is necessary to systematically access the resources offered by the students themselves. We can resort to the timely assistance of a more advanced student, or we can regularly pair up students in difficulty with students who are better able to master the subject matter[23].

Remediation periods

In this situation, the general academic organization is significantly altered. Two levels of remediation are possible:

- Initial remediation

A typical example of this type of remediation for learning gaps would be that of a science course in which several students are lacking well-defined portions of the prerequisites. Once the diagnosis has been made, two options are presented for the first three weeks of the course: a) students who are not sufficiently prepared receive intensive teaching in order to bring them up to par; and b) more prepared students follow an enriched study plan with content that is not essential to the course but highly useful for their future studies. This is a solution for everyone. And this formula can be used over a long or short period of time.

- Periodic remediation

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[22] It goes without saying that a new professor would not have many of these tools, nor the experienced professor who is assigned a new course at the last minute: it takes years of practice and research in the same course to have both the competency and the time needed to create such teaching material.

[23] Many things can motivate student-tutors: altruism; the certainty of having the opportunity to perfectly master the subject matter; the opportunity of earning a certificate "of assistant-professor" added to the diploma; improved self- image; and others.

This consists in putting aside a certain number of weeks during the trimester, during which time the course is devoted to bringing slow starters up to speed and providing activities that promote deeper learning for quick learners.

Phasing of performance levels

Each course includes a minimum content applicable to all as well as optional contents; and also a minimum and a maximum level of performance for each of the contents. Differentiation can play a key role here.

In terms of content, we must recognize two borders: one, below which passage to the next course is prohibited; and the other one, still quite a distance away, that corresponds to a desired ideal, that is not necessarily to be reached during the course. This is a key distinction, which it makes it possible to keep students in the group who will only assimilate the minimum of contents required, whereas others will maximize their potential as regards the contents of the course. In such a case, it is a matter of setting objectives that exceed more or less the minimum requirements for students in difficulty and to propose more challenging objectives for more capable and motivated students.

As we have seen, this can be done in the classroom through the use of enrichment exercises. It can also take place at the time of initial or periodic remediation; or it may be carried out within various work projects. It can also be achieved through the use of different-level goals among which students can choose.

In terms of requirements, we can suggest challenges that are more or less demanding. For example, certain students may be asked to use only their memorization and ability to apply scientific formulas; whereas others would be asked to master the meaning of the formula as well as the principles from which it emanates.

To conclude this long list of differences in learning rates and ways to respect them, we can affirm that it may be the single aspect that poses the greatest challenge because it raises questions about the objectives, the content and the general organization of the course.

CONCLUSION

It has probably become obvious while reading the various possibilities and suggestions presented in the text that all of this cannot be accomplished within a single pedagogical organization.

The final choices will be guided mainly by the specific constraints relative to the course in question. However, whatever the context, it will always have to incorporate the following three major characteristics:

First, we have to vary education with the greatest number of aspects in order to simultaneously reach the majority of students, and make sure it is spiralled, i.e. that it calls into play in successive manner the various learning stages for each important concept as suggested by Kolb: a) Concrete Experience, b) Reflective Observation, c) Abstract Conceptualization and d) Active Experimentation.

Secondly, we must be able to offer the necessary means and remedial steps for students who are less well prepared and for slower learners. As well, we must plan for enrichment work for the students who are faster, more advanced and eager to broaden their knowledge.

Thirdly, we must always seek to put the student at the centre of the teaching activity, on one hand because only the student can actualize his learning and, on the other hand, because ultimately, only the student can differentiate learning, i.e. by using his own brain, at his own rate, and in his own way.

Text 2

New educational strategies versus the traditional method What are the differences?

The principles of a good educational strategy!

Ulric Aylwin, pedagogical development coordinator at Cégep de Maisonneuve in 1992, answers the above question in his text entitled *The principles of a good teaching strategy.* The excerpts are taken from volume 5, no 4, of *Pédagogie collégiale*, published in May 1992 (p. 11-15) and from volume 6 no 1, of the September 1992 issue (p. 23-29).

For Ulric Aylwin, "*Teaching is an art wherein the professor, the students and the environment interact in an ever-changing and original way that can never be reduced to transferable or reproducible instructions. Each professor constructs his own teaching models and uses them constantly and systematically. However to be effective, the art of teaching must obey general rules and guiding principles that are applicable to all situations, whatever the level or subject matter. These principles arise mainly from the nature and functioning of the brain and from psychic processes occurring on intrapersonal and interpersonal levels, as well as constraints relating to the school environment*."

The principles of a good educational strategy

Ulric Aylwin

Teaching is an art wherein the professor, the students and the environment interact in an ever-changing and original way that can never be reduced to transferable or reproducible instructions. Each professor constructs his own teaching models and uses them constantly and systematically.

However to be effective, the art of teaching must respect general rules and guiding principles that are applicable to all situations, whatever the level or subject matter.

These principles arise mainly from the nature and functioning of the brain and from psychic processes occurring on intrapersonal and interpersonal levels, as well as relative to constraints found in academic environments. What follows is a brief presentation of twenty guiding principles to assist the professor in the effective use of his art.

1. Students must prepare for each course.
2. The course must be at a level that makes good use of the professor's expertise and experience.
3. The course must provide students with answers to questions that are topical, real and personal.
4. At the outset, the course must destabilize the student and contain a sufficient emotional charge.
5. The course must begin with a recap of previously acquired knowledge.
6. Each course must begin with "advance organizers".
7. There must be frequent formative evaluations within each course.
8. The students must be able to evaluate by themselves the quality of their learning and their work.
9. As much as possible, each student must be at the centre of the learning activity.
10. The rules applicable to attention and memorization must be respected.
11. Students must teach each other.
12. The concrete must precede the abstract.
13. It is necessary to assure the transfer of knowledge and skills taught within the course.
14. Teaching must support all types of intellects and all learning styles.
15. It is necessary to develop the capacity for metacognition (thinking about thinking).
16. The student must be able to see the usefulness of what he does.
17. Students must learn in the here and now.
18. Cooperation is preferable to competition.
19. Teaching must take into account the functioning of the brain.
20. In-depth learning should be targeted by cultivating higher-order cognitive skills.

1. *Students must prepare for each course*

There are a several reasons for this:

Initially, preparation makes it possible to reduce the gap between students' knowledge of the subject matter to be studied. We know that one of the obstacles facing education today is the heterogeneity of groups in terms of acquired knowledge. As a result, the professor usually chooses an average rate of progress, thus sacrificing the least advanced students in class and alienating the most advanced learners. However, with thorough and precise preparation, all students can be at the same starting point at the beginning of the course.

Secondly, it forces each student to acknowledge his problematical areas relative to the upcoming learning tasks.

Thirdly, it makes it possible for the professor to devote course time to activities other than subject review and the presentation of elementary concepts. This point is the basis for principle No 2.

Student preparation can relate to various aspects of the course content:

- A review of concepts needed to integrate the new subject matter;
- A methodical study of the new subject data and concepts via questions submitted in advance;
- Work on a case method or problem situation relating to the subject matter;
- Providing answers to a pre-test on the course subject;
- Preparing questions on the upcoming course subject.

This preparation must be verified or sanctioned in some way at the outset of the course.

2. The course must be at a level that makes good use of the professor's expertise and experience

As we will see in principle 13 on knowledge transfer, it is up to the professor to "give meaning" to the content of his course by demonstrating its future use.

However, the specific role of the professor in class is much more varied than that. Without listing the multitude of tasks he must achieve, we know that he needs all the time available in the course to handle the activities that require his expertise. This is not possible if he spends half the time teaching the rudiments of course content, i.e. basic concepts that the students could and should have learned before attending the class.

It is important to implement the principle of student preparation, for each course, and also adopt the principle that class time should be spent on activities that make good use of the professor's expertise and experience if we wish to avoid the widespread teaching syndrome of "never finding the time to cover all the subject matter"; and, if we wish to make students accountable[24]".

[24]When we say that the course must call upon the specific resources of the professor, this does not mean that he must be at the centre of the cognitive activities. It is rather the students who must be at the centre of the teaching activity, but the kind of activities

3. The course must provide students with answers to questions that are topical, real and personal

This principle deals with the actualization of intrinsic motivation.

Common sense and teaching experience show us that students who study hard, assimilate the learning tasks and persevere in their studies all share the characteristic of being intrinsically motivated, i.e., they seek through their studies, the means and opportunities to improve the quality of their personal life. This fact is confirmed by various scientific studies (Bissonnette 1989, Nuttin 1980, Wlodkovski 1978).

We presume that at the start of the course, the professor will have taken care to enlist the fundamental motivation of students for the general content. However it is also necessary to ensure that each new topic has a "subjective" meaning for the student.

This may have been achieved at the end of the previous week's course, during the presentation for the upcoming course, or perhaps the preparatory study on the course will have created heightened awareness; in any event, we must make sure that the student does not consider the course to be "just one more course" but rather an opportunity to appropriate important elements for the quality of his life.

4. At the outset, the course must destabilize the student and contain a sufficient emotional charge

These two viewpoints are complementary.

Initially, it is necessary to get the student out of the homeostatic, intellectual or emotional balance which he finds quite comfortable and from which he does not see the need for making any particular effort to integrate the course content. We must therefore awaken concern, curiosity and any other emotion apt to motivate him to make the cognitive effort.

It is necessary for the destabilizing element to possess a sufficient emotional impact to ensure adequate interneuron excitation and achieve deep engrammation in the brain. Cognition without strong emotion simply does not exist.

The emotional impact must be positive, i.e. not threatening. If it is threatening, there is a risk of regression in the activity of the brain and cortex in favour of the limbic system (seat of the emotions), with a consequent inhibition of learning potential. (Refer to principle no 19).

5. The course must begin with a recap of previously acquired knowledge

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undertaken by the students require scientific and methodological "guidance" that can only be provided by the professor.

There are two kinds of previously acquired knowledge: acquired knowledge in the case of concepts already studied, and spontaneous preconceptions or theories in the case of new subject matter.

David Ausubel was the first to state that the most determining factor in learning is what the student already knows (Ausubel 1968). Just as well-known is the insistence of Jerome Bruner on the importance of cognitive structures created by humans from the moment of birth and used to interpret all new cognition (Barth 1985).

In a more elaborate fashion, proof of this was provided by Giordan and Vecchi in their book *Les Origines du savoir* (1987), which relates how acquired preconceptions and knowledge survive with all their gaps and weaknesses, beyond the knowledge received at school. This conflict is also the title of the book by Philippe Jonnaert, *Conflits de savoirs et didactiques* (1988), which highlights the interference caused by old knowledge in the acquisition of new knowledge.

All of the above leads us to conclude that what is required prior to presenting any type of content to students, is the reactivation of past knowledge, whether accurate or not: what they have already acquired on the subject and spontaneous preconceptions and images. This will ensure a meeting between old and new knowledge and their interaction, making it possible for gaps to be filled and the new learning integrated. Together, they will offer a unified understanding of the concepts under study.

6. Each course must begin with "advance organizers"

We owe the concept of "advance organizers" to David Ausubel (Ausubel 1975). These statements and questions at the start of each course are designed to help "organize the thoughts of the students in advance". These organizers can take the form of a summary of key points of the upcoming course, a statement of questions and problems that the students should solve by end of course, or a recap of the general outline of the entire program being careful to precisely position the new content within the overall structure. Experience has shown that students display greater interest, take better notes and understand more deeply when the professor begins his course with "advance organizers".

The purpose of these organizers is not simply to direct the student's attention to the new content, it also creates a bridge between the student's previously acquired knowledge and the content of the course about to begin, which in turn respects principle number 5.

7. There must be frequent formative evaluations within each course

There is no effective learning without evaluation; this is obvious to anyone who observes how an athlete constantly measures the scope and impact of his actions.

Similarly, it is necessary to provide the student with ongoing feedback on the effectiveness of his cognitive capacities in the form of a purely formative evaluation.

The formative evaluation is of utmost importance for the student. To begin with it confirms his learning and highlights his gaps, orients the upcoming study and finally, it constitutes a crucial and constant source of re-motivation for him. He is rewarded by his success and challenged by his weaknesses and failures.

The formative evaluation is also of utmost importance for the professor: it is his only means of measuring the results of his past teaching and orienting his future actions.

Ongoing or frequent formative evaluation is an absolute condition of effectiveness. Unfortunately, it is one of the least respected teaching principles and a major reason for the high failure rate at collegial level.

8. The students must be able to evaluate by themselves the quality of their learning and their work

This principle is an important corollary to the preceding one. It is not sufficient for the professor to measure the learning of students: each student must measure his own learning, for each activity. The reason is twofold:

First and foremost *for the student*: how can we increase our knowledge or produce better work if we do not measure the quality of our thoughts and actions. It is necessary to methodically develop within each student the ability to evaluate his intellectual activity on all levels.

Secondly, *for the professor*: it is a must if he expects students to produce significant work without his having to do all the evaluations. Within the framework of self-evaluation and inter-evaluation, it is important that students measure the quality of their work themselves, on a formative basis, with the professor acting as a resource person only.

9. As much as possible, each student must be at the centre of the learning activity

The truism that only the learner can learn – meaning it is the responsibility of the student to carry out the cognitive operations connected to learning – is not known to the majority of professors who monopolize class time and the cognitive activities occurring therein. This conclusion is drawn from an analysis of 200,000 hours of course videos taken in 42 states of the U.S. and 7 countries. The videos show that the professor speaks more than 80 percent of the time. Even more startling, during the period of time when students are most active, only 10 percent of this time is devoted to cognitive capacities other than memorization (Griffin 1986).

If we are to respect the principle that the student is responsible for his own learning, it is necessary for the majority of professors to completely reverse their strategy. The transformation requires a classroom centered on the student and not focused on the professor.

Introducing effective educational strategies is challenging. However, we must rise to the challenge for three essential reasons:

First and foremost, so the student may learn: our initial truism.

Secondly, so the student may study according to his own style, intelligence type and learning rate. There are so many differences between students that only the student himself can truly respect his own learning style. And that is only possible when he is in charge of his own learning process (Aylwin 1991).

Thirdly, so students have opportunities for mastering the language at the same time as the learning task. It has been shown that memorization and reactivation of knowledge is related to the context where the learning took place and that each discipline represents a specific context with its specific vocabulary, language style and way of structuring knowledge. The student must learn to read and express himself within this context, otherwise he will never adequately master the language (Aylwin 1989).

10. The rules applicable to attention and memorization must be respected

With respect to a subject, the brain can remain attentive on a continuous basis for about 10 minutes. Therefore, it is important to punctuate a presentation with short periods of reflection, discussion or evaluation, and to vary the way in which we solicit attention, by resorting to examples, metaphors, anecdotes and other means.

The rule to follow in presentations is simple: proceed in a spiral fashion by assigning different cognitive operations to each concept to facilitate assimilation of the concept and also, to revive attention and avoid overloading short-term memory.

It is necessary to respect the functioning of short-term memory (working memory). We know that this memory is limited: it can handle five to seven elements at one time, and if time or the processing mode is insufficient, data stored will not be transferred to long-term memory, but will be lost instead. We must make it possible for the brain to process data in a sufficiently varied and prolonged manner to ensure storage in long-term memory, while providing sufficient anchoring points to ensure the knowledge can be located and recalled at a later date (Aylwin 1988). Hence the need for spiral teaching.

Long-term memorization requires the reactivation of knowledge at given intervals. Reactivation is usually done at the following regular intervals: after ten minutes, at the end of the course, after twenty-four hours, after one week, one month, and three months (Buzan 1979). It is very important to consolidate learning every ten minutes to renew attention and support long-term memorization.

11. Students must teach each other

Lucius Annaeus Seneca stated a long time ago that 'to teach is to learn twice'. Every professor knows from experience that we only realize all that we don't know about a subject when we try teaching to others, and that only after explaining the same subject several times do we truly begin to master it. This reality calls for regularly putting the student in situations such as doing a presentation on course content, offering constructive feedback or preparing a synthesis on the subject matter. Making the student perform actions more typical of the professor is the best way of ensuring effective learning Moreover, research on memory has shown that we remember 20 percent of what we hear versus 70 percent of what we formulate ourselves (Woods 1989).

Interteaching among students can take all kinds of forms: presentation, teaching display, panel, seminar, short discussion, work in sub-groups, debate, role play and others. What counts is the frequency more than the duration and also the continuous use of formative feedback based on precise criteria.

12. The concrete must precede the abstract

It is wrong to accuse students of deficiencies in formal thinking. More often than not, it is the professor who uses abstract terms incorrectly to elaborate on abstract concepts: abstract concepts can only be developed starting from concrete objects or situations.

This is why the learning process of David Kolb (1981) begins with the concrete stage of experience before moving on to reflection and abstract conceptualization.

This is also the reason why David Ausubel proposes an elaborate form of "advance organizers", a structuring metaphor or analogy, in which we begin by evoking in detail a familiar concrete structure and then grafting the structure of abstract knowledge upon it, point by point,

The growth of the mind is similar to the growth of a tree: for each additional metre of branch that wants to reach the sky, the tree must first deepen and strengthen its roots in the soil. In the case of Einstein, his brilliant mathematical concepts emerged from his manipulation of concrete images. And Descartes owes the discovery of his rationalism to three creative dreams.

Thus, metaphors, examples, case methods, anecdotes, manipulations, demonstrations, simulations, games, visualizations and others are all helpful. They are also effective when applying the next principle which focuses on the transfer of knowledge.

13. It is necessary to assure the transfer of knowledge and skills taught within the course

Almost all professors recognize and deplore the fact that students do not transfer theory into practice, nor do they transfer theory from one course to the other within the same discipline: This is known as the phenomenon of separate drawers.

A number of researchers have tried to identify the causes of this generalized phenomenon. Among them, Resnick (1987), Ennis (1989), Perkins and Salomon (1989), Brown, Collins and Duguid (1989), Alexander and Judy (1988) emphasized the differences between learning that takes place in everyday life and in professional practices versus learning acquired in an schooling context. Whereas the “real” world contains complex objects, vaguely defined problems and situations where the individual must identify his own objectives and meaning, the academic environment contains ready-made laws and formulas applicable to well-defined problems and pre-determined objectives along with the use of a symbolic language.

This difference between the two contexts and cultures hinders the transfer of knowledge between the two environments.

Let us specify that this partitioning is due to the fact that knowledge is stored in long-term memory along with the attributes or stimuli associated with the context where the learning took place. Future recall of that knowledge will not occur if there is no connection between the current reality and the initial school framework. There is however a solution to the problem: include the greatest number of future applications in the academic environment to support the transfer of knowledge in learning and memorization processes.

At the very minimum, the professor should use examples, applications, anecdotes, descriptions, simulations, situation scenarios and other teaching methods that evoke as concretely as possible, a variety of contexts for future application.

On a more elaborate level, the professor can resort to so-called context-rich methods, i.e. methods of greater complexity presenting similar requirements to what would be found in current practices and actual professional situations. Most well-known of these is the case method, which was made popular by the Harvard Business School. In this situation, knowledge and skills are acquired during problem solving processes that are every bit as complex as those found in professional practices given that case methods are taken from real experiences (Christensen 1981).

Another similar and more thorough method is that of “Problem-Based Learning” (PBL), practiced in several faculties of Medicine in the United States and developed also at McMaster University in Ontario. This method consists of building all the knowledge and skills to be learned in the course around the solution of a series of key problems. The curriculum of the faculty of Medicine of l’Université de Sherbrooke is structured entirely on this model (Dieijen 1990).

Lastly, the teaching formula that achieves top marks in learning integration and transfer of knowledge is cooperative learning, in which time is shared between study in an educational environment and work in a professional environment. The faculty of Administration of l'Université de Sherbrooke and the Faculty of Educational Sciences at Simon Fraser University in Vancouver are good examples of the application of this formula.

The above suggestions are considered to be the most effective ways of ensuring the transfer of knowledge. Other teaching guidelines can help increase the probability of transfer. A list of these is provided by Jacques Laliberté in two summary reports on the transfer of knowledge (Laliberté 1990). In conclusion, the authors believe it is crucial to:

- highlight the important elements when a new subject is introduced;
- identify the fields of activity in which the learning task applies;
- define the knowledge and strategies required ;
- identify other fields where the same learning and strategies can be useful;
- encourage students to persevere and resort to various means when their efforts at problem resolution prove ineffective…

To paraphrase Rabelais, we could conclude here by saying that "science without transfer is nothing but ruination of the mind".

14. Pedagogy must support all types of intellects and all learning styles

Educators have always known there are important differences between students, but several relatively recent factors have broadened and accentuated the scope of these differences.

Recent studies on the brain, the nature of intelligence and the learning process brought to our attention differences hitherto unknown in these domains.

In addition, the disappearance of grouping by aptitudes (reduced, full and enriched) or by vocational orientation has resulted in very heterogeneous groups in the same class.

Moreover, school democratization has filled the classrooms with students from diversified social groups, with cultures, interests and ideals that have little in common with those of the previously selected minority.

To top it off, the massive return of adults to “regular” school has inserted a new dynamic that is sometimes difficult to manage. And lastly, the increase of students from varied ethnic groups has accentuated the variegated character of the student population.

Professors now find themselves in front of such vastly heterogeneous groups that it is quite difficult to keep track of all levels of preparation, all styles of learning and all types of motivation.

One of the solutions is to introduce differentiated instruction, a teaching structure that offers various approaches for sub-groups formed on the basis of common characteristics, and a variety of stimuli broad enough to reach the diversity of student needs.

There are several ways of differentiating instruction.

The most effective way to take individual differences into account is to entrust the student with control over his learning process. No professor, no matter how skilful or experienced, can succeed in taking into account all the differences among his students as long as he remains the person doing most of the cognitive work in the classroom. It is necessary to try and transfer this responsibility to the students, by making them accountable for the stages and activities involved in the acquisition of knowledge. Only the individual can think and learn while effectively respecting his own type of intelligence, cognitive style, learning rate and all the other traits that are exclusive to his personality.

As concerns the difference in learning rates, the least that should be done for the slower (or least prepared) students is to provide an outline, preparatory exercises, simple questions, self teaching guides and so on; at the same time, provide additional challenges for the faster learners to allow them to deepen their knowledge and broaden their culture. A more efficient way of taking this diversity into account is to have a catch-up period for the less advanced students at the very start of the trimester, and then later, provide time for remedial work and reinforcement. (Details of the preceding and following text can be found in *Une pédagogie différenciée*, Aylwin, 1991).

Another way to take student diversity into account is to let students choose the teaching formula they prefer: tutoring, teamwork, attendance in class, individual learning in the media centre, or others. Finally, another way of taking diversity into account when the entire group is in the classroom, is to continuously vary the means used to stimulate students' attention. These variations can involve:

- methods of grouping students;
- ways of transmitting information;
- actions performed by the students;
- cognitive activities required for the course;
- types of content in the learning task;
- suggested exercises;
- teaching methods;
- work rates;
- enrichment levels (For details, see text above).

In conclusion, we can see from this overview that differentiated instruction is very demanding for the professor. It implies that he is skilled at diagnosing the differences between students, masters several teaching formulas and has the required didactic material. This may appear difficult but it is necessary, otherwise even the best educational program cannot succeed.

There exists admittedly another solution for taking into account student heterogeneity. It consists of seeing the differences not as a problem but as a teaching tool. This is cooperative learning, in which differences are systematically explored in teams where student diversity is carefully distributed. Cooperative learning is the subject of principle 18.

However, cooperative learning or any other formula cannot adequately support the various student categories without injecting a good amount of differentiated instruction into the mix.

15. It is necessary to develop the capacity for metacognition

The key difference between strong students and weaker students is their ability to manage their cognitive capacities, i.e. to be conscious of their thinking and to adjust their approach to problem solving, as required.

This capacity for "metacognition" has two facets: a self-evaluation of abilities or cognitive capacities and self-management of these capacities. (Paris and Winograd, 1990; Pinard, 1987; Bouffard, 1987).

The absence of metacognition results in a situation where the student does not study because he wrongfully believes he is ready for the test; or, he repeats the same error from work project to work project.

A capacity for metacognition is the ability to reflect before answering, to plan out work, to readjust an approach at any time and revise the work when it is done. The effects of metacognition on learning are of major importance.

Firstly, metacognition makes it possible for the student to be more active and independent within the learning process.

Secondly, it makes the student more conscious of his own way of thinking and thus allows him to benefit more from differentiated instruction.

Thirdly, it facilitates the student's cognitive growth by allowing him to build on his mistakes and successes.

Fourthly, it is a skill that can be easily developed and integrated into the teaching processes used in class.

Fifthly, and this is a major point, metacognition plays a central role in motivation. Motivation vis-à-vis a task is often defined as an "expectation of success" and as a "value accorded" to the results of a task (Feather, 1982). However, a student's expectation of success depends entirely on his metacognition, i.e. his ability to correctly evaluate his own level of knowledge and skills.

The following three factors play a key role in the student's motivation: self image, attribution (internal or external) of results and a feeling of learned helplessness. So we can plainly see how a student's capacity for metacognition makes a difference when it comes to developing a negative or positive attitude.

Fortunately, as previously shown, the professor can greatly contribute toward the development of metacognition in his students.

The first method is to present a formal detailed outline of the stages of the process, *(direct explanation*) to the student.

- what is metacognition?
- why use it;
- how to apply it;
- how to evaluate its success (Paris and Winograd, 1990, p. 32 and 33). By regularly proceeding in this manner, the professor encourages the students to objectify their cognitive capacities bit by bit.

Moreover, the professor can use various processes to cultivate metacognition directly. Here are five examples.

<u>Methods for cultivating metacognition</u>

The exchange of course notes

At certain intervals, the professor introduces a five-to-ten-minute period in the course devoted to the exchange of course notes: students A and B exchange notes to compare content and form. This allows for:

- the recognition of another way of thinking;
- a comparison of the ways of organizing course notes;
- thorough assimilation of the subject matter via exercises in metacognition

Answers centered on the process

Within a formative setting either in class or at home, or within a summative framework, we present a problem for students to solve. The only elements provided are: the process to follow, the reasoning that should take place and the stages to complete.

The student must not provide an answer, but rather produce a list of questions that should be asked, and describe the approach that should be used: this is one way of putting the accent exclusively on reasoning.

Observation-listening to others

This exercise never ceases to fascinate participants. It unfolds as follows:

Three students: A, B, C. – Three time periods.

1. A and B endeavour, aloud, to solve a problem. C observes and takes written notes to describe the reasoning used, as A and B work to resolve the problem. C then tells A and B what he has observed.
2. A and C: repeat the process (change of roles).
3. B and C: repeat the process (change of roles).

This activity makes it possible for each individual to observe two different ways of thinking (metacognition); it also supports a better assimilation of the subject matter.

(*Note*: Observation notes can be kept. The exercise is then repeated two months later and a comparison done to show progress achieved by each student.)

The professorial model

The professor unexpectedly asks a question, introduces a problem to be solved or proposes a case study.

But instead of asking the class to respond, the professor himself plays the role of student and, aloud, tries to formulate an answer. This gives students the opportunity to see "thinking in action" and to observe a model of a "student" in the process of thinking or studying.

Questions that lead to reflection

It is the simplest way albeit not the easiest. It consists in having students reflect on their way of thinking. To simplify this activity, four categories of questions can be asked of the student:

- **The origin**:
  - What led you to this conclusion?
  - What context was used for reference?
  - What knowledge or experience guided you?
- **The basis:**
  - Why you believe this?
  - Do you have proof?
  - Why are people of this opinion?
  - Is it a good hypothesis?

- **The confrontation:**
  - What would you say to people who do not share your opinion?
  - Why does your answer differ from others?
  - Could you support the opposite viewpoint?

- **The consequences:**
  - What will happen if we agreed with your thinking?
  - What would it take to apply your ideas?
  - If we agree with you, would it not require that?

Developing metacognition is within the reach of any professor and is surely one of the best means of increasing student motivation while making them independent in their learning process.

16. The student must be able to see the usefulness of what he does

The surest and fastest way to destroy the credibility of the professor and the motivation of the student is to make the student do work for which he sees no personal usefulness.

Let us point out some classic examples of this. First, the case of a professor who insisted his students read a text in preparation for the course and then because certain students did not read the text, began his course as if no one had done the reading. The message is clear: from now on there is no need to do what the professor asks, since he will act as if it had not been done. Then, there's the case of work being done in sub-groups, after which the professor continues the course without building on the results of this work. The message is clear: he made us discuss just to pass the time, it was not really useful. Lastly, the case of language requirements, where the professor after having clearly established that learning tasks cannot be mastered without also mastering the language in which it is expressed, proceeds to give examinations where mastery of the language is optional. The message is clear: we can succeed in this subject regardless of our level of mastery of the language.

The situations described above (and there are many others) are destructive in two ways. Initially, they show the incongruity between what the professor says and what he does, which results in students rejecting future requests; secondly, and this is undoubtedly more damaging, the students do not have any means of "seeing" the result of their efforts.

We must overcome two complementary challenges before we can apply the present principle.

First, it is necessary to always re-use any work done by students immediately following its production. For example, even the smallest reading request and the most commonplace discussion must be revisited immediately if knowledge is to be constructed.

Secondly, each student must take stock, on his own, of what he acquired in each piece of work done. Concretely, this requires that the professor administer a sort of pre-test before any activity, then a post-test, so that each student can "see" the path his learning has traveled thanks to his investment in this activity.

This last requirement is not always easy to respect, especially in non-quantitative disciplines such as philosophy for example, and less structured methods, like work in sub-groups; however it is necessary… and possible.

17. The students must learn in the here and now

There is a generalized defeatism on the part of professors who choose to believe that the only thing a student can do during the course is “follow” as closely as possible what is being taught, and from the students’ perspective who choose to believe that it is enough to simply take notes. This state of affairs is far from a normal situation where students are expected to assimilate approximately 80 percent of the subject matter in the classroom, during the course itself.

Why should such a result be considered normal, or even essential? We have already provided many reasons, here are few more.

To begin with, given that the classroom is “when and where” a professor can give his students the benefit of his expertise and experience (principle 2), it follows that it is within this privileged contact, and not afterwards, that the student has the best chance of assimilating the subject matter. It is in class and nowhere else that all of the following take place: interteaching, preparation for the transfer of knowledge, metacognition exercises, and high-level cognitive activities as well as the first stages of long-term memorization.

Moreover, the time a student disposes between classes must be devoted to preparing for the next class (principle 1).

18. Cooperation is preferable to competition

Cooperative learning is when students regularly provide mutual assistance to each other in order to attain the best individual and collective results. Coincidentally, research and experiments during the past century show that students learn better in an environment based on cooperation rather than a climate of competition.

This reality can be explained by the fact that students learn more, both quantitatively and qualitatively, in a context that provides mutual assistance. The reason is simple. This mutual assistance provides students with greater emotional security. As will be seen in the following principle, a student is unable to fully use his cognitive capacities when disturbed emotionally and, especially, when he feels his personal and/or social image is under attack; because this causes a narrowing of the field of perception (Combs et Snygg, 1959) and the activity of the neocortex is decreased by the action of the limbic system, seat of the emotions. Thus, one of the first advantages of cooperation is to provide the student with a reassuring emotional framework that is also favourable to studying.

Other cooperation advantages include:

- the possibility of social interaction;
- the use of interteaching;
- the access to metacognition;
- the use of complex cognitive capacities
- the development of communication skills;
- the active involvement of the student;
- learning how to work in a team
- learning about and accepting differences.

The success of cooperative learning does not happen by accident. To achieve success a number of conditions need to be respected, including the following:

- establish a team goal or “reward” for the team;
- give each member a specific responsibility;
- ensure that each member has equal opportunity to progress;
- maintain a balance between the groups;
- assure student motivation;
- assure the professor’s preparation

(All these elements are explained in greater detail in *L'apprentissage coopératif*, Aylwin, 1992).

We will end this presentation on the principle of cooperation with a citation from Robert Slavin (1987), who states that schools are starting to enter the “age of cooperation”, owing to the fact that we have begun to realize that our most under-utilized resource in academic establishments is the student himself.

19. Education must take into account the functioning of the brain

Paul MacLean’s research on the brain (1973), enhanced by the thinking of Henri Laborit in *Mon oncle d'Amérique* (1979), and Leslie Hart in *Human Brain and Human Learning* (1983), emphasized the co-existence of three superimposed brains in the evolution of mankind (refer to the synthesis by Richard, 1988).

The most ancient, the reptilian brain, is the seat of instinctive, unconscious and instantaneous reactions with a very limited repertory of responses. In the event of a major threat to an individual, the reptilian brain automatically takes control of the action.

The middle brain (emotional), the paleomammalian (limbic system) brain, is the seat of emotions and memory. The key role of emotions in all our actions and, singularly so in the case of learning, is well known. For Jeanne Miller (1990), emotions are the "new frontier" in the field of the education, because "positive emotions are the primary and essential ingredient in the learning process" and that is why she attaches so much importance to cooperative learning. Similarly, D.L. Mumpower (1973), who had previously studied the effect of emotions on learning, also noted the impact of the former on the latter.

R. Caine et G. Caine (1990) derived twelve teaching principles from their study of the brain. They state, in principle 5, that emotions play a key role in building models of knowledge. They refer to several other researchers who showed that emotion and cognition are inseparable and that, in the case of memory, the emotions play a central role in information storage and retrieval.

Consequently, perhaps the greatest illusion shared by a majority of professors in whom we entrust student learning is the belief that the "students" in front of them have highly evolved brains, i.e. "neocortical", brains that are reasonable and hungry for science, whereas in reality, they are in the presence of 200-million-year-old reptilian brains with a mammalian addition that goes back 60 million years, and a recent cortical appendage only a few million years old: a slow and fragile organ easily disturbed by emotions.

In practice, every educational strategy should take into account this brain structure and the preponderance of emotions in the learning process. This reality, which permeates all educational dimensions, should lead to various daily actions, some as simple as allowing students at the start of the course, to verbalize their fears, frustrations, or stress, or by giving them the time to decompress and re-centre themselves. [25]

There is another aspect of the brain that must also be considered in the preparation

[25]Those familiar with the general semantics of Alfred Korzybski (1933), and thus readers of the works of Alfred Van Vogt (1953), will recognize the importance here of the "corticothalamic pause", an exercise whereby an individual in the throes of panic is taught to alternate between the stages of recourse to cortical rationale and confrontational moments with the emotions of the limbic system. It is also one of the fundamental methods of "neurolinguistic programming" formulated by Richard Bandler and John Grinder (1979), in which mental dissociation is used to rebuild traumatic experiences of the past in a healthy way.

of our educational strategies: the brain's ability to handle enormous quantities of information in a millisecond.

The brain contains some 30 billion neurons, the majority of which can establish between 10 and 20 million interneuron connections. This gives us an idea of everything that can occur in a student's brain in the period of one second, one minute, one hour... (on the number of neurons, see Hart, 1983; Renaud, 1987; and Changeux, 1990).

Moreover, the complexity of the neuronal interaction grows constantly, owing to the fact that each cognitive action literally creates new dendrites which then proceed to create more contacts with other axons. (For the functioning of the brain, see Delacour, 1978; Grinvald, 1983; Bullier, 1983; Ferry, 1987; Fawcet, 1986; Goldin, 1988; *Science et Vie*, 1987; Renaud, 1987).

The educational consequences of this hyperpower and hyperactivity of the brain are crucial, since they relate to all the phenomena of perception, attentiveness, data processing, motivation and more. Not surprisingly, developing this hyperpotential is the most difficult aspect to actualize in a concrete manner within an educational strategy.

The main challenge here is to provide the brain with a sufficiently rich environment, whereas a classroom is typically an aseptic environment on the sensory level, in which the thin, slow and linear thread of knowledge unwinds at a snail's pace. (For differences between the natural environment and the school environment, see Sherman, 1983)

Similarly, Caine and Caine (1990) define this problem in their first principle in which they describe the brain as a parallel processor of various operations. Unfortunately, they do not propose any concrete solutions. After enumerating all the simultaneous actions of the brain, their only practical suggestion is to recommend that professors find a way to orchestrate all these possibilities in their teaching.

More concretely, several elementary schools in the United States have started "brain-based education" or "brain-compatible schools", to create rich environments where the student can participate according to his interests, needs and abilities, in one or more of the various activities taking place simultaneously.

When it comes to teaching, how could we take into account all of the brain's stimulation needs? Complete answers remain to be found, but we already have partial answers in the text on differentiated instruction (Aylwin, 1991), where the possibility of using enriched-context methods is discussed.

In short, we still have much to do to create educational strategies that take into account the structure of the brain, with particular emphasis on the role of emotions in learning, and the power of the brain, together with the diversity of teaching formulas that this requires.

20. In-depth learning should be targeted by cultivating higher-order

cognitive skills.

Observation of student behaviour reveals that it can be divided according to two attitudes vis-à-vis learning. On the one side, there are *surface learners* for whom memorization and the mechanical application of formulas is enough. They do not make a clear distinction between principles and proof. Their objective is limited to meeting the minimum requirements of the professor. On the other side, there are *deep learners* who seek to understand the structure and significance of the overall knowledge in question, to connect these new concepts to personal experience, to distinguish between proof and argument, to give structure to the content, and to identify links between the recommended tasks and personal development (see Kember, 1991 and Romano, 1991).

The study above relates to the student's viewpoint. There is, conversely, a way of looking at it from the perspective of the professor's objectives, which must support the in-depth learning of his students. To reach this goal, the professor must centre his teaching on high-level cognitive capacities, which, according to research compiled by Lauren Resnick (1987, p. 3), present the following characteristics:

- high level cognitive capacities are not algorithmic: all is not decided in advance;
- they are complex: one cannot adopt a viewpoint right from the start;
- they offer various solutions;
- they lead to well-defined judgements;
- they call upon many criteria, sometimes contradictory;
- they tolerate uncertainty, since all the required information may not be available;
- they imply that each individual can self-regulate, without having to solicit constant assistance;
- they imply that we can find order within disorder, by ourselves;
- they obviously require considerable and constant effort.

The data reported by Kember, Romano and Resnick in the preceding lines emphasize the complexity involved and the personal commitment required for in-depth learning. How is all this actualized in a teaching strategy? In practice this requires the application of most of the principles enumerated so far, in particular:

- n° 1 preparatory work of the students;
- n° 2 use of classroom time for complex activities to deepen knowledge;
- n° 3 intrinsic motivation of the students;
- n° 9 place of the student at the heart of the teaching activity;
- n° 11 interteaching;
- n° 13 transfer of learning;
- n° 14 differentiated instruction;
- n° 15 metacognition;
- n° 19 appropriate use of the brain.

Summary

It would be risky to try to summarize the twenty principles described by grouping them around two or three dominant themes. This would likely reduce the scope and specificity of each principle.

On the other hand, what comes through very forcefully is the need for placing the student at the centre of the teaching activity, as principal actor and first person in charge: it is the only really effective way to respect the functioning of the brain, different types of intelligence, attention spans and learning styles as well as ensuring in-depth learning. In such a context, the professor's role is amplified to some extent since he is responsible for creating all the situations and providing the learning tools required by such dynamic education, and since he must intervene notably to ensure the depth and transfer of learning.

To conclude, it should be noted that the twenty principles examined do not cover the totality of laws or fundamental requirements of good education; certain dimensions are not developed sufficiently here. Among other themes which should also be studied, there are:

- the role of challenges in student motivation;
- the importance of developing cognitive capacities;
- the need for taking into account student characteristics such as field-dependent or field-independent, self-image and the attribution of effects.

Moreover, the entire field of attitudes and values remains to be explored.

Hopefully, the principles presented here already provide a useful base for professors. These principles rest on solid research and provide a scientific foundation for a profession that will always remain an art: teaching.

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Text 3

A new educational strategy: Cooperative learning.

Ulric Aylwin, pedagogical development coordinator at Cégep de Maisonneuve in 1992, describes this strategy in text 3: *Teamwork: why and how?* This text is taken from volume 7, No 3, of *Pédagogie collégiale*, March 1994 (p. 28-32).

To enable those who want to deepen their exploration of this approach and put it in practice quickly and effectively, Ulric Aylwin's text is followed by the table of contents of the two following books.

1- **Johnson**, **David W**., **Johnson**, **Roger T**., **Holubec**, **Edythe J**., *Cooperative learning in the class,* ASCD, Alexandria, Virginia, 1994.

2- **Philip C. Abrami, Bette Chambers, Catherine Poulsen, Christina De Simone, Sylvia d'Apollonia et James Howden**, *L'apprentissage coopératif Théories, méthodes, activité*s, translation of *Classroom Connection*s, Les Éditions de la Chenelière inc., 1996.

Teamwork: why and how?[26]

Ulric Aylwin

Well structured teamwork can be a source of student motivation. Teamwork also supports in-depth learning and makes it possible to respect student diversity.

The challenges confronting professors nowadays are very complex, in that they are made up of diverse and inextricably interwoven elements. Among these challenges, five are particularly demanding.

- How to maintain student motivation
- How to galvanize students into action and get them to take control of their own learning process
- How to cope with the increasing heterogeneity of student groups
- How to support in-depth learning
- How to provide students with a framework that prepares them for their future work

There are many ways of meeting these challenges, but one method deserves special mention owing to the fact that it incorporates all the objectives, and more.
This method involves the formation of student sub-groups.

This method can also be implemented in an informal way, used occasionally for exercises of short duration, or in a more structured way over a period of several weeks or even an entire trimester, in which case the method can truly be called cooperative learning. This is the form of teamwork we are dealing with here.

Initially, we will examine how cooperative learning functions. Then we will see how this method makes it possible to overcome the challenges mentioned above. Finally, we will discuss its effectiveness.

COOPERATIVE LEARNING: characteristics and methods

In cooperative learning, all the aspects of group activity are carefully and systematically selected, arranged and managed to maximize learning and socio-affective benefits. There are three dominant characteristics of cooperative learning:

- It supports a positive interdependence among team members: members have a common goal that can be achieved only through the contribution and success of each individual and the sharing of individual resources.
- It requires the individual accountability of team members on two levels: on one hand, it is necessary for each individual to do his share to ensure attainment of the common goal, on the other, it is necessary for each individual to prepare for the summative

[26] Text taken from a conference presented February 2, 1994, at Cégep de Saint-Jérôme, within the framework of buffet-conferences presented by the AQPC.

evaluation that is administered individually.

- Thirdly, depending on the nature of the socio-affective objectives targeted by the professor, the teams are made up on the basis of heterogeneity. This heterogeneity will be the broadest possible and be equivalent from one group to the next. Concretely, if such diversity exists in the classroom, each team of four students could contain one strong student, two average students and one weak student, two males and two females, one or two members of cultural minorities, etc. Let us specify that the heterogeneity of teams is not an absolute rule. For our part, we prefer to use a model that implies this heterogeneity, in addition to the positive interdependence and individual accountability of team members.

Cooperative learning can be adapted to a wide variety of methods or formulas. Spencer Kagan[27] describes up to 94 exercises and 20 lesson outlines relative to the principal objectives of a given course.

The **puzzle** and **bonus points for performance** are two particularly interesting formulas.

There are other less elaborate methods, such as READ - SUMMARIZE – TEST (RST). Here students in dyads read a text section by section. After reading a section, student A then provides a summary to student B, without referring to the text. After this, B, who listens to the summary while consulting the text, completes the information retained by A. Then the roles are reversed for the study of the next section. Other formulas are more elaborate. Such is the case of Coop-Coop (CC) and Team Research where the students themselves determine the subject matter for the entire course and distribute its contents among the teams, thus ensuring an interdependence at all levels: a) between all individuals - for the choice of the content and the work plan; b) among all team members - for the particular task entrusted to the team; c) between all teams - to carry out the totality of the study or the research.

The description of these formulas is found in the work by Kagan and a book published by Concordia University[28].

ADVANTAGES OF COOPERATIVE LEARNING

Cooperative learning makes it possible to meet the five challenges listed above.

Two formulas for cooperative learning

THE PUZZLE

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[27] KAGAN, Spencer, *Cooperative Learning*, San Juan Capistrano (CA), Resources for Teachers, 1992.

[28] Centre for the Study of Classroom Processes, *Using Cooperative Learning*, Concordia University, 1993.

This is the cooperative formula par excellence where interdependence among the team members is evident and where students have the most opportunities to improve their study methods and their communication abilities.

The puzzle is practiced in two forms.

Form 1

- The professor divides the subject matter into as many sections as there are members in the teams (four usually); the sections are numbered 1, 2, 3, 4. Students in the teams are identified by the letters A, B, C, D.

- The professor hands out section n° 1 to all the "A" members of the teams, section n° 2 to the "B" members of the team, and so forth. Initially, each student works alone on the task entrusted to him (he does it at home or in the classroom), then all the A members meet, as do the B, C and D members respectively, to constitute "expert" groups on their section of the subject matter. They deepen their understanding of the subject matter to be able to explain it later to the members of their original team.

- When the "experts" have finished studying their section of the subject matter, they rejoin their original team and share their knowledge, i.e. person A teaches B, C and D; then it is B's turn, etc., until all members master the subject matter presented by each.

The evaluation then proceeds individually, as usual.

Form 2

What differs here from form 1 is that each student receives the entire text or documentation. The general approach remains the same in that each team member is required to study one section only or to consider one specific viewpoint while studying the entire document.

BONUS POINTS FOR PERFORMANCE (BPP)

This formula is designed to reinforce the interdependence of team members and to give each member a chance to contribute to the success of the team. Standard procedure is as follows:

- Teams are heterogeneous.
- The professor teaches a section of the subject and informs students that the individual evaluation will focus on this content.
- In their respective teams, students deepen their knowledge by working with the questions, problems, answer sheets and other documents distributed by the professor. The fact of giving each team a section of the questionnaire, or a single answer sheet encourages cooperation between team members much more than if each individual were given all the material. Once the study period is over, each student's knowledge is tested with an exam whose form and content make it possible to clearly distinguish individual performances.
- After correction, the score of each individual is compared with the score he obtained for the preceding exam and the professor averages the percentages of individual progress for each team (there is no loss of point for any setback experienced by a team member); this positive progress is then translated into bonus points which benefit all the members of the team.
- To reinforce team spirit, the professor can publicly congratulate the team whose average progress percentage is highest after each exam.

Motivation

One of the first advantages of cooperative learning is that it creates a climate of emotional security for the student. We all know that many of our students have a relatively negative image of themselves and that some of them suffer from what is called "an acquired feeling of learned helplessness". It stands to reason that these students can only become more anxiety-prone if they are placed in a competitive arena where the strength of some is measured against the weakness of others or where the victory of some requires the defeat of others. Moreover, research like that of Paul MacLean in particular[29], has demonstrated that

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[29]MAC LEAN, Paul, *A Triune Concept of the Brain and Behavior*, University of Toronto Press, T. Boag and D. Campbell Editors, 1973.

the activity of the brain in the cortical area is inhibited when the limbic system, seat of the emotions, becomes the most active, i.e. when emotions take over from reason. In other words, students' motivation and cognitive capacities are conditioned by the emotional security provided by the teaching environment, and this is what cooperative learning can offer.

Another source of motivation in cooperative learning comes from its socio-affective dimension, which comprises several aspects. First, learning is primarily a social phenomenon, where interaction with others is necessary to obtain information, transform it, validate it, use and transmit it. It is thus necessary to insist on the fact that individual, silent and passive listening is not natural. Only dialogue, the clash of different viewpoints, and sharing, which are natural activities, truly help students renew their motivation on an ongoing basis.

Moreover, the group dynamics initiated and developed within a team cause each student to express the various facets of his personality and to link his emotional life to his intellectual life, which is an essential condition of motivation.

Student activity

There is only one global criterion for judging the effectiveness of an educational approach: it is the diversity and the quality of the cognitive capacities that it awakens in the student, without which, learning will not take place. However, we know that the lecture, a method which has its own effectiveness, is an approach that is low in terms of cerebral activity for the student, because, in this case, it is the speaker who does most of the work while the student struggles to try and make sense of the continuous flow of words to which he is subjected.

Cooperative learning, on the other hand, places each student, at every moment, at the heart of the cognitive activity and in control of his personal learning approach. It is therefore a natural complement to the professorial presentation, a complement that should be weightier than the presentation itself. It is also necessary to emphasize, in connection with the preceding point on motivation, that getting the student out of his inaction, isolation and passivity is a key factor in maintaining motivation.

Respect of individual differences

Group heterogeneity has become the key obstacle in course planning and communication in class. The sources of heterogeneity are numerous: gender and age differences; disparity of school preparations; socio-economic, cultural and motivational variations; ethnic diversity;

stages of intellectual development; cognitive structures; types of intelligence; learning styles; types of perception (VAK: visual, auditory, kinaesthetic); learning rates; sources and forms of motivation.

All of this represents a major – if not insurmountable – difficulty for the professor, if he tries to solve the problem by himself. He can certainly attenuate the problem by using differentiated instruction, i.e. instruction that links, simultaneously or successively, principal sub-groups with common traits. But the limitations of this differentiation are quickly reached. The real solution consists in resorting to cooperative learning, in which differences are no longer seen as obstacles, but rather as a means to learning, and in which, more importantly, each student is in control of his own approach to learning, which makes it possible for him to work at his own rate and according to his own style, while taking into account all his other personal characteristics.

In-depth learning

It seems that the majority of students are content with “surface learning”, without really trying to understand the structure and significance of the overall knowledge in question, to link new concepts to personal experience, to distinguish between proof and argument, to organize the content, to find links between the proposed tasks and personal development … in short, without undertaking the cognitive activities required for in-depth learning.

Surface learning means memorizing the day before the exam, being unable to apply the knowledge to problems or situations that differ from those studied in class, and quickly forgetting after the exam any knowledge that was previously memorized.

Given this state of affairs, cooperative learning constitutes one of the best approaches to support in-depth learning. Within a cooperative framework, the work required of the student causes him to exercise a whole range of cognitive capacities: analysis, synthesis, feedback, creativity, problem solving, decision making and metacognition. As shown by Ausubel and Bruner, two renowned experts on cognition, the depth of understanding of a concept is proportional to the variety of cognitive activities performed on the concept – and this is precisely what results from work and discussions done in a cooperative learning context.

Teamwork in preparation for one’s future profession

In the near future, the ability to work in a team will be one of the essential goals of most collegial programs. An analysis of workplace practices demonstrates the importance of this ability for many contemplated professions. For teaching students how to work in teams, the role of cooperative learning is self-evident and it is not necessary to underscore it further.

Cooperative learning can definitely help us meet the five challenges listed at the start of this section. Other important results have also been achieved with this method, such as the cultural and social integration of students from ethnic minorities, emotional and educational support for weaker students, improvement in communication skills, implementation of continuous formative evaluation and the development of a personal value system.

CONDITIONS OF EFFECTIVENESS

There are two categories of conditions: those relating to the preparation and those relating to the proper functioning of the method.

Conditions required for getting the method underway

At the outset, we must make sure we know the characteristics of the students, and that they, in turn, understand the advantages of cooperative learning. It is also necessary to ensure that teaching material and physical conditions are appropriate.

- As was stated earlier, all teams must be heterogeneous in the same way and on the same level. For this, the professor must be able to collect the relevant information. As for the students, if the professor plans to use a sociogram to identify the affinities of each, they must also be given the opportunity to become familiar with the results themselves.

- Cooperative learning is very demanding for students from an intellectual, social and emotional perspective; if care is not taken at the beginning, to make them aware of the links between this method and their fundamental needs, as well as the program objectives and the demands of their future profession, students will refuse to commit themselves or will do so against their will. It is essential that teamwork not be perceived as an arbitrary or lightly-taken decision by the professor.

- It is also necessary to ensure that all the work to be done in teams is such that it cannot be accomplished individually, either because of the magnitude of the task, or because the team must produce a collective work, or again because the desired learning involves major socio-emotional aspects. In other words, it is necessary for the student to see for himself that it is essential for him to cooperate with his team members to accomplish the task at hand.

- Since students are called upon to do the work by themselves, it is crucial that the professor provide them with the necessary texts adapted to each particular group in terms of legibility, with reading lists, formative evaluation tools and any other suitable tool. In addition – and this is an often neglected aspect – it is necessary that the theme or problem selected be accessible to the average student. It goes without saying that the furniture and arrangement of the room itself must support the creation of small groups; while sound-proofing must make it possible to support a relatively high level of noise.

Conditions that ensure the proper functioning of the method

We draw your attention here to positive interdependence, personal accountability and learning how to work in a team.

- Positive interdependence consists in the perception that we are linked to others in such a way that we cannot succeed without having them succeed as well, and vice versa, or that our efforts must be coordinated with the efforts of others to accomplish the task. This interdependence must exist within each team; it can also exist between teams if the same objective is shared by several teams, or the entire class. There is negative interdependence when there exists – in one form or another – competition, whereby the success of some is achieved to the detriment of others. The perception of positive interdependence within a group can originate from various sources: the members can be interdependent on the basis of established goal, shared means or the particular competencies of each team member.

- Personal accountability is a requirement for individual work and in the summative evaluation. As regards the work, it is necessary to ensure that each team member, in each task, assumes his share of the work. This is achieved through the socio-affective pressure felt by each individual owing to the fact that the image, reputation or benefit to each and every individual can be compromised by the lack of preparation of a single team member. As for the summative evaluation, performance will usually be evaluated individually; but the professor may, in order to reinforce interdependence, grant bonus points to the team whose average individual score shows the greatest increase since the preceding exam, as described above.

- Given the possible reservation of certain students with respect to teamwork and, more importantly, to facilitate the harmonious and effective operation of the team, it is necessary to support the positive dynamics occurring within groups and, if need be, show members how to proceed to resolve conflicts. Initially, we should prepare exercises to allow team members to get to know each other quickly and to appreciate both their differences and commonalities. Then each member will be asked to assume a specific role that will contribute to the smooth operation of the team. Each team will be asked to regularly examine its functioning, using evaluation grids provided by the professor. For his part, the professor will attentively observe the functioning of the teams, so as to identify the skills which seem to be lacking, such as the art of providing constructive feedback, the art of problem solving, of organizing work, etc., and he will implement short training periods to develop these skills.

The three conditions above are crucial. Also, it is important that the standard principles of teaching be respected in cooperative learning. The list below is particularly relevant.

Suggestions for roles in a teamwork context

Moderator: Person who ensures the participation of all, reduces tension and makes sure the group progresses according to the timetable, etc.

Secretary: Person who will speak on behalf of the team, if necessary, or who will draft the final report.

Documentalist: Person who makes sure that the group has the necessary documentation and who keeps the group's portfolio.

Questioner: Person who makes sure that the maximum amount of information is obtained from each team member and that the group does its best with respect to every item under discussion.

Observer: Person who observes the operations of the group as concerns the work process and social interactions, and then provides feedback at the end.

To properly carry out the activity, it is necessary to complete the following tasks:

- Before each new learning task, ensure that every student is aware of his own mental and cognitive capacities, and can identify his own level of competency, in order to solidly build the foundation on which the new knowledge will rest.

- Ensure that at the end of the task every student re-assesses his knowledge, so that he may review his progress and thus see the usefulness of the requested task, which will also reinforce his intrinsic motivation.

- During the task, provide the necessary tools so that each team can evaluate by itself the quality of its operations and its learning.

- Prepare for the highly probable eventuality that some teams will progress slowly and others more rapidly and, consequently, make available auxiliary tools for the slower teams and enrichment questions or exercises for the faster ones.

- Validate the results of teamwork by re-using these in the next stage of the course.

The above conditions can be considered essential, but others could be added.

Conclusion

From all that we have seen, cooperative learning is a method which demands specific requirements. For this reason, improvisation can only lead to disappointing results for both the students and the professor.

On the other hand, it should be stressed that the models described above are not rigid and there are many possible variations, both in content and composition of teams as well as in the process itself, based on the objectives of the professor or the context in which the course is given. Let us specify, moreover, that it is not necessary for all groups to be formed the same way; sometimes students can work within their initial heterogeneous group and sometimes with those who share personal affinities or by levels of academic strength.

We should also keep in mind that a professor eager to use a given form of teamwork has a broad continuum to choose from, ranging from simple mutual assistance offered occasionally between students to a sophisticated model of cooperative learning.

In summary, what is important to remember are the unique possibilities provided by teamwork, which can greatly assist a professor overcome the challenges confronting him on a daily basis.

Contents at a glance

Johnson, **David W.**, **Johnson**, **Roger T.**, **Holubec**, **Edythe J.**, *Cooperative learning in the classroom*, ASCD, Alexandria, Virginia, 1994.

"Learning is something students do, not something that is done to students. Learning is not a spectator sport." (Page 4)

Contents at a glance

Philip C. Abrami, Bette Chambers, Catherine Poulsen, Christina De Simone, Sylvia d'Apollonia et James Howden, *L'apprentissage coopératif Théories, méthodes, activité*s, Traduction de *Classroom Connection*s, Les Éditions de la Chenelière inc., 1996.

Theoretical basis

Implementation

Choice of methods

Appendices

Text 4

A new educational strategy:
The Case study.

Yolande Van Stappen, professor in office management techniques at Cégep Joliette-De Lanaudière in 1989, defines this new strategy in text 4: *The case method*. This text is taken from volume 3, no 2, of *Pédagogie collégiale*, May 1989 (p. 16-18).

Ms. Van Stappen also authored, at Cégep Joliette-De Lanaudière, *L'enseignement par la méthode des cas*. This research published with the assistance of PAREA, earned her an encouragement award in the 1989 Prix du Ministre contest.

For those who want to examine this approach in greater depth so as to implement it quickly and effectively, the text by Yolande Van Stappen is followed by a summary of the table of contents of a useful book:

Wasserman, **Selma,** *Introduction to Case Method Teaching A Guide to the Galaxy*, Professors College Press, New-York, 1994.

The Case Method
Yolande Van Stappen

The case method, made famous by Harvard University, uses problems taken from real life situations, applied to a variety of fields: history, biology, chemistry, communications, medicine, law, management, etc. This approach makes it possible for students to deal with concrete cases "[...]in particular to exercise their intelligence for making a diagnosis, formulating problems accurately despite complex criteria relating to importance and urgency, finding answers that offer the most complete solution to the problem in question, and working toward implementing these solutions by choosing the means and planning the activities.[30]"

Characteristics of the case method

The case method involves three stages: first, the student does an individual analysis, which leads to a diagnosis of the situation. This is followed by a discussion in small groups to argue the different diagnoses, formulate and prioritize the problems to be resolved, build a solution. Thirdly, in a plenary session, the group discusses the various theses as well as the advantages and disadvantages of the solutions put forth by the small groups in order to arrive at an effective solution.

In the case method, the professor serves as both the person who brings knowledge and who moderates the discussions. The professor must:

- Choose the case according to the established goals: prepare the necessary theoretical documentation and decide in what format it will be transmitted to the students: oral presentation, course notes, written documents, research by the students, etc.

- Prepare the case: study the case and find the greatest number of possible solutions; investigate the solutions so as not to be caught unawares.

- Moderate the case: to allow the participants to express themselves fully, the moderator should not impose his views on the process; be careful not to orient discussions toward his own solution and should encourage students to express themselves freely. He should initiate discussions whenever necessary; play the role of team member with the same rights as others; get the discussions back on track when the group strays (this method is effective when a control is exerted); ask questions that open venues of exploration; report on the progress of the

[30]GUY, Serraf, *Dictionnaire méthodologique du marketing*, collection ADETEM marketing demain, Les Éditions d'Organisation, Paris 1985.

discussions; and summarize debates at the most appropriate times (situational judgment).

- Ensure a follow-up on the cases: summarize the discussions, orally or in writing; require that each group recap their discussions and solution(s); and transmit this information to each and every group member.

For the students, a case poses a concrete problem taken from real life that calls for a diagnosis or a decision. The case study presupposes that the students carry out four essential operations:

- analyze the case (identify the facts and the links between them, which can require reading and a search for information required to understand the case);
- make a diagnosis (interpretation of the relationships discovered between the various case elements; judge the existing situation; and study possible solutions);
- make a decision (choose the best solution);
- conceptualize (deduce some practical operational principles or rules from the cases studied that are applicable to similar cases or situations).

Other important aspects of the case method are the approach used and the process of analysis used to find a solution, the coherence of the analysis process and not just the finding of one correct solution. As a matter of fact, two groups can arrive at different solutions which are both applicable and likely to be effective.

Educational value of the case method

The case method can be seen as an invaluable complement to the lecture. A lecture transmits information, knowledge, concepts (theoretical courses), but the student plays a passive role and experiences difficulties in establishing links between theory and practice. A lecture cannot provide experience. The student loses much of his motivation owing to the fact that he does not immediately see where the teaching leads. Moreover, numerous studies have shown that this method does not develop the ability to analyze, synthesize or judge and does not favour attitude changes. The case method, on the contrary, allows students to indirectly acquire experience based on concrete problems and to develop a higher level of skills; it also increases their motivation to learn.

Acquisition of experience

Experience is not something that can be transferred or given to another: "Wisdom can't be told"[31], and yet, most of our concepts come from the experience of others. Through the use of the case method, students take an active part in a process that is close to reality and also leads to a strong individual involvement in the learning process. They learn how to obtain information not only within the case itself, but from other sources as well; they learn how to conduct research, how to identify information and also how to learn from other students. Knowledge integration occurs and two types of transfers are carried out:

1. One must apply the theory found in books and other sources to the situation described in the case. This provides the link between theory and practice.

2. Applying what is studied in the classroom prepares for real work situations. The students will be able to make these transfers more quickly once they become active in the work force.

Skill development

The case method develops a certain number of specific skills:

- Ability to communicate, to defend one's position vis-à-vis a group, orally (discussion, oral communication) or in written format (report on case analysis and arguments in favour of the adopted solution); in the latter case, writing skills are developed;
- Ability to make decisions and to trust in the decisions taken;
- Ability to solve problems, which develops the ability to analyze, synthesize and judge (higher order skills in Bloom's taxonomy); the case method also develops cognitive capacities during individual case studies;
- Interpersonal skills: group projects support the development of interpersonal skills. Each individual learns how to express and defend his opinions with clarity and precision, to welcome feedback, to listen to and accept the opinions of others, to evaluate his own opinions, to compare them with those of others and modify them as needed. Similarly, being confronted with the viewpoints of other students allows for the recognition of value judgments within a specific action. This can have an influence on a young person's morals and ethics. The role of facts and values in the decision-making process are put into perspective. Role play in the case method is particularly well suited for this purpose.

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[31] GRAGG, Charles I., *Because Wisdom Can't be Told*, HBS Case Services, Harvard Business School, Boston, p.6

Increased motivation

Student motivation is increased, because there is less routine in the classroom (various problems are studied, discussions take place in small groups and also in plenary sessions); students see the possible links between theory and practice and realize that this will benefit them when they enter the labour market. It is easier for them "to absorb" the information, because the case is founded on a real life situation, unlike simple lectures that are removed from reality. Moreover, students will more readily recommend solutions when they feel they are not accountable and that the solutions are not really binding. Lastly, the adult returning to school accepts data more readily when it is provided in cases than any other form: the result is increased motivation.

Inherent limitations to the case method

The case method has certain limitations. Even though it is possible to establish a link with reality, the case is not the same as reality: information is filtered through the writer's perception; the communication of perceptions is not perfect since there are third-person interventions. A given case that highlights a particular situation taken out of context is often limited to one type of problem or provides an incomplete perspective. This can impact problem comprehension. Effectiveness is compromised: was the entire subject matter covered? Unlike lectures, the content cannot be totally controlled. Moreover, identifying problems and finding solutions requires more than simply taking notes dictated by the professor. The case method requires good preparation on the part of the professor and the students. This method also requires spending a fair amount of time in the classroom to bear fruit. According to several authors, anywhere from ten to fifteen sessions of two to three hours per week are needed for the method to be effective. Like all active methods, the formative value of the case method is weak initially, increases over the next ten to fifteen classes and progresses very quickly from that point on.

Research on the educational value of the method

Much research and many studies, some lasting twenty years, have impacted the case method. Dale Beckman[32] gathered and compared the results of this research relative to five aspects. 1. Information acquisition; 2. Information retention; 3. The impact on attitudes and behaviour; 4. The ability to analyze, synthesize and integrate information; 5. Student preference for the case method. All comparisons are made in relation to the lecture method.

With regard to information acquisition, there is little or no difference between the

[32] BECKMAN, M. Dale, "Evaluating the Case Method", in *Educational Forum*, 34, 4, May 1972, pp. 489-497.

case method and the lecture; however, information is retained much longer in classrooms using the case method or any method based on discussion. Similarly, the case method and discussions are more effective than presentations for developing the ability to analyze, synthesize and judge and for bringing about long-lasting changes in attitude and behaviour. Lastly, studies show that students prefer the case method. "… the students clearly indicated their preference for the case method and the instructors realized this very quickly. This student attitude was a determining factor in accelerating the use of the case method in the classroom[33]."

The educational value of the case method has been proven. It is, in many ways, superior to the lecture and not inferior to it, but rather equal with regards to the transmission of information. It engages the student actively in his learning, teaches him how to learn, how to make justified assessments and develop a higher level of skills: analysis, synthesis, evaluation. Although it requires more work, the student prefers it to the lecture. If the method is not used more frequently, it is certainly not for educational reasons, but rather because of the restricted number of students per group, the availability of appropriate locations (to support discussions in small groups and in plenary sessions) and special preparation on the part of the professors.

One solution would be to train professors on the case method (collective development, through PERFORMA or other means), to provide cases for the collegial level and to allocate the resources needed for education based on the case method.

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[33] *Ibid.*, p. 497.

Suggested reading

ANDREWS, Kenneth R., *The Role of the Instructor in the Case Method*, Harvard Business School Case Services, Boston, 8 p.
BRIEN, Robert, Ph. D., et DORVAL, Esther, B. Sc. Ed., *Le choix des méthodes d'enseignement*, practical guide, Québec, 1984, pp. 124-127.
CHRISTENSEN, C., Roland with Abby J. Hansen, *Teaching and the Case Method*, Harvard Business School, Boston, 290 p.
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COREY, Raymond E., *Case Method Teaching*, Harvard Business School Case Services, Harvard Business School, Boston, 18 p.
ERSKINE, James A., LEENDERS, Michiel R. et MAUFFETTE-LEENDERS, Louise, *Teaching with Cases*, Research and Publications Division, School of Business Administration, The University of Western Ontario, London, mars 1981, 305 p.
MC ADOO, Joe (Drury College) et NELSON, Paul (University of Missouri), «Teaching Speech Communication via the Case Method», in *Today's Speech*, vol. 23, n° 3, summer 1975, pp. 29-32.

MERRY, Robert W., *Preparation to teach a case*, HBS Case Services, Harvard Business School, Boston, 4 p.
MUCCHIELLI, Roger et OLMSTEAD, Joseph, *La Méthode des cas de Harvard*, Université de Montréal, 15 p.
TOURNIER, Michèle, *Typologie des formules pédagogiques*, Research undertaken at collège de Maisonneuve, Direction générale de l'enseignement collégial, May 1978.

Contents at a glance:

Wasserman, **Selma**, *Introduction to Case Method Teaching A Guide to the Galaxy*, Professors College Press, New-York, 1994.

Texts 5 and 6

A new educational strategy: Problem solving approach

This new educational strategy was defined by the following two authors:

1. **Lise Poirier Proulx**, assistant to the director of PERFORMA at Université de Sherbrooke in 1997, described this strategy in an article entitled *Enseigner et apprendre la résolution de problèmes*, taken from Vol. 11, no 1, of *Pédagogie collégiale*, October 1997 (p. 18-22).

2. **Bernard Legault**, professor in electrical engineering technology at cégep André-Laurendeau in 2000, described his in-class experience using this strategy. The article entitled *La résolution de problèmes en Techniques de génie électrique* appeared in May 2000 on pages 42 to 45 of *Pédagogie collégiale* (volume 13, no 4).

Bernard Legault was a member of the follow-up committee for the establishment of new programs in the field of electrical engineering technologies from 1992 to 1995. A member of the local committee responsible for drafting the 'student success' policy at cégep André-Laurendeau in 1991, he was also a member of the editorial board of Pédagogie collégiale from 1992 to 1997. Among his previously published works are two articles appearing in Pédagogie collégiale, October 1993.

For those who want to explore this approach in greater depth in order to implement it quickly and effectively, we recommend the following reading: **St-Jean, Madelaine**, *L'apprentissage par problèmes dans l'enseignement supérieur*, Service d'aide à l'enseignement, Université de Montréal, Montréal, 1994. Also, you will find at the end of texts 5 and 6, an overview of chapter five of **Laurier, Busque**, 1998, Montréal, 'La demarche fonctionnelle de resolution de problèmes', in *Cinq stratégies gagnantes pour l'enseignement des sciences et de la technologie*, Chenelière/McGraw-Hill, member of Chenelière Éducation, P. 109-164.

Text 5
Teaching and learning problem solving[34]

Lise Poirier Proulx

The capacity for solving problems is a complex ability whose development requires specific knowledge, attitudes and aptitudes as well as frequent and considered practice in situations that are meaningful for the students.

The ability to solve problems is one of the most important manifestations of our ability to think and a crucial component of intelligence. It is rated as one of the most complex operations in taxonomies that categorize cognitive acts (Gagné, 1985; D'Hainaut, 1985; Beyer, 1988).

Essential to any individual in a society that confronts him with increasingly complex challenges over the entire range of human activities, this capacity has notably become an indispensable requirement of the workplace which relies on the creative potential of all employees to solve a variety of difficulties facing organizations on a daily basis.

However, in the curriculum of academic establishments, problem solving capacities almost always appear only as an objective to be pursued through teaching and learning activities, or interventions by the personnel assigned to support teaching activities.

At the collegial level, developing problem solving skills must be considered above all as an essential component of basic education. As a result, this skill should appear both as a personal development goal and as a key educational component in all teaching disciplines. Because this skill does not develop "spontaneously as a by-product of knowledge acquisition" (Romano, 1992), professors are encouraged to find ways to support its learning so as to enable their students to face various everyday situations as adequately as possible, both individually and collectively, and to solve problems relating to their current or future professional context.

From a constructivist perspective on learning which is the approach embraced here, learning to solve problems means undertaking, in an active and cumulative way, a process of construction, a change in the cognitive structure that makes it possible to develop effective action. To date, we do not have a fully structured and well-articulated approach based of the constructivist approach to learning.

In consulting the documentation, we were able to identify a certain number of elements that need to be taken into account in any educational activity designed to develop a problem solving process.

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[34] Those who wish to learn more about this approach can see their local representative to consult a work published by the author of this text, *Cadre référentiel pour l'utilisation ou le développement de la résolution de problèmes en enseignement*, PERFORMA collégial, 1997, 232 p.

The ability to solve problems

Based on research results and observations carried out on the teaching of problem solving, Woods (1987) offers six proposals to be considered in the development of this skill in the student. We should mention here that these proposals are consistent with the various components of the cognitive process associated with problem solving.

It is difficult to differentiate between knowledge acquisition and learning how to solve a problem

There are two aspects to consider regarding the links between knowledge in a given discipline and problem solving: importance and accessibility. The need to possess a specific repertory of knowledge in order to be able to effectively solve problems is a well-known truism. This repertory enables an individual to process in a meaningful way the facts of the case and to work out suitable solutions. It is one of the factors that differentiate the behaviour of a beginner from that of an expert. Research has shown that, on one hand, when experts are faced with problems for which they don't have the basic necessary knowledge, they behave appreciably like beginners; whereas, on the other hand, beginners who have acquired the necessary specific knowledge create solution scenarios similar to those of experts for whom the problem is familiar.

However, the fact that an individual has acquired knowledge relating to a given context does not guarantee that he will be able to recall it at the opportune moment. Such is the case of inert knowledge, i.e. previously acquired knowledge that is inaccessible at the time it is needed within a new context. So, the ability to call upon knowledge is essential to solving problems.

It seems that the way in which we store information as we learn it impacts our problem solving process. Research shows that individuals who are able to solve problems adequately have developed a base of knowledge structured around concepts or fundamental principles organized in a hierarchical way. This base contains major clues, evolves according to the need and includes conditions under which all concepts can be included.

In addition to a quality organization of knowledge in memory, Prawat (1989) affirms that the degree of awareness of what we know or do not know on a given subject also exerts an influence. This notion is at the heart of the distinction between explicit and tacit knowledge. Explicit knowledge is acquired through the process of reflection. It is used creatively and can be consciously transformed. Tacit knowledge is acquired in an intuitive way, through experience, without being subjected to a process of reflection. Used on a routine basis, it is often only understood superficially.

This ability to be aware of the state of our knowledge is a mark of intelligence that increases with personal development. It plays an important role in the comprehension of phenomena specific to a field. It is important that tacit knowledge be identified, better understood and recovered to become part of our base of explicit knowledge.

The professor must directly intervene in the construction of the specific knowledge base of the student. According to Tardif (1992), this is an initial conclusion to be drawn from research on problem solving in relation to teaching. It is also necessary to ensure that the components of this base can be recalled at the opportune moment.

To be effective and transferable, learning must be done within a discipline and include real life problems

This principle is linked to the preceding one in that, problem solving strategies require a context and take place in a situation that requires specific knowledge. It is through this accumulation of contextualized experiences of problem solving that specific strategies develop which can be recalled and used when a similar situation occurs. Training that takes place in a context which is not related to the discipline or to real life, would be much less effective in developing these strategies and would be meaningless for the student. This reasoning is what led Collège Alverno, recognized for its educational approach based on the development of fundamental skills, to reorient its approach to problem solving and integrate it, at the outset, to the actual course content (O' Brien *et al.*, 1991).

This principle is also linked to current practices in *Situated Learning,* according to which the learning content should be integrated and used in tasks or in problem situations that mimic situations students will encounter in the future (Collins *et al.*, 1989). This enables students to make their entry, so to speak, into the socio-professional world.

The approach targets the following objectives:

- to demonstrate to students the usefulness and the possible applications of acquired knowledge;
- to support the active participation of students in their learning;
- to bring students to recognize the conditions in which their knowledge is

applicable;

- to support the transfer of knowledge to new contexts.

We must present problems and not exercises in order to develop a problem-solving process

Whereas problem solving requires an active search for solutions that are not obvious at the outset, an exercise is, to some extent, the repetition or recreation of known operations in order to learn and master them. This is the case with situations - often wrongly called problems - in which the student only has to apply procedures that he has been taught. The use of exercises can be completely validated for certain types of learning, but it cannot lead to the development of a problem-solving strategy that requires a process of reasoning to work out the most suitable situations.

It is necessary to teach the process explicitly, and not simply have students solve problems like automatons

In order for problem-solving learning to become meaningful for students and enable them to achieve greater effectiveness and autonomy in the use of the process, it is essential that they become aware of the stages they follow and strategies they use in the process. This means it is necessary to implement teaching approaches that allow them to identify the most adequate strategies for structuring their models of the different types of problems they will face, and to work out the most suitable solutions to these problems. It is not only necessary to assure the quality of results obtained through the resolution process, but also the quality and effectiveness of the process itself.

It is necessary to introduce sufficiently meaningful and complex problems to develop the skills connected to the process

The cases presented must lead the student to face the same type of cognitive challenge he is likely to encounter in solving problems in real life. This implies he will be faced with poorly defined problems of ever increasing complexity. However, it will be necessary to adjust the level of difficulty based on current knowledge or knowledge to be acquired, and pay attention to the development of other skills required for problem solving, in particular those connected to decision making, critical thinking and creative thought.

Individual differences must be taken into account in developing abilities: learning style, level of cognitive development, attitude, etc.

There are many differences between students. It is essential to understand that every human being, since the very first few months of life, seeks to understand the world in which he lives, by building models and explanatory conceptual models that are his and his alone. The professor must take into account the various ways in which each individual accedes to and uses knowledge. Each individual also has his own way of approaching and solving problems, and this must also be taken into account.

Among emotional factors, motivation plays a key role in learning. In problem solving, it is associated with regulation operations that influence the choice of task that will be given priority, interrupted, abandoned, or will benefit from increased or decreased cognitive effort. To awaken and maintain motivation, professors must not only present problems that are meaningful to all students, by taking into account the differences between them, but also provide the necessary emotional support to help each student persevere in his efforts, identify his successes and help him overcome difficulties.

Within a developmental framework of cognitive skills

Beyer (1988) identifies four important dimensions in the teaching of cognitive skills that apply to problem solving and which complete the six propositions that we have just seen. They are: the learning environment, the use of course contents, the teaching style, and the use of a systematic and structured approach. To these dimensions, we added one more that seems relevant: the use of teamwork.

The learning environment

The professors must create a classroom atmosphere that is favourable to reflection and discussion, an environment that facilitates creative vision and diversified concepts as well as new ideas. This educational environment supports the development of cognitive skills, has room for initiative and welcomes challenges. The approaches employed facilitate self-expression, call for the clarification of ideas, respect moments of silence and necessary pauses, stimulate original ideas, take into account the ideas of each individual and support interaction. In order to create an environment favourable to the acquisition of cognitive capacities, it is necessary to take the time required to acquire a process and this leads the professor to be more a "process facilitator" than a "transmitter of contents".

The physical location is another important factor. It must provide room for consultations on work done and the use of learning materials. In addition, it must support professor/student interactions as well as student/student interactions.

Using course content

In addition to the previous propositions of Woods on this point, Beyer stresses that the content chosen for the development of the skill is also a valuable and useful element. To resolve "artificial problems" may prove to be an interesting means of teaching the skill, but it is absolutely necessary to use authentic cases that will be meaningful to the student. Course content must lend itself to the development of skills and it is essential to present problems with varied contents in order to facilitate the transfer of learning.

Teaching style

The professor must identify the most appropriate time and means to clearly explain the ability to be acquired. For example, he could introduce a number of strategies supporting problem resolution when the students are given a problem to resolve or have difficulty identifying a problem, even after several attempts. Demonstrating the importance of critical thinking in problem solving can be very meaningful when students are faced with choosing one solution among a certain number of possibilities. Teaching a strategy without a context is likely to lead to the development of 'recipes' rather than processes that can be applied intelligently.

The use of a systematic and structured teaching approach

Based on observations made during training activities, Beyer stresses a certain number of considerations in the learning of complex cognitive capacities from which we can establish a broad outline for a systematic and structured approach to teaching:

- the mastery of a complex skill requires, at the outset, an important cognitive involvement;
- in the first stages of learning, the emphasis must be placed on the skill to be acquired while avoiding disturbance from other learning;
- the initial teaching must be followed by guided, frequent and regular practices;
- to facilitate the transfer, it is necessary to allow the student to use the skill in several contexts and to offer him guidance;
- in order to recognize the conditions under which the skill must be used, it is necessary to present cases or tasks that are less defined than those in the initial stages, and require different cognitive strategies.

The use of teamwork

We should not lose sight of the social side linked to learning and we must also recognize that teamwork is very beneficial in the development of cognitive capacities, in particular within a cooperative learning approach.

This approach supports the positive interdependence of team members and demands personal accountability. Through the use of heterogeneous groups, a certain number of socio-affective objectives identified by the professor can be achieved. We can briefly review the advantages of this approach, by referring to the work of Aylwin (1996).

Learning the problem solving process can sometimes cause emotional insecurity in students, directly impacting their level of interest and the time they will invest in the tasks. Fear of failure can also cause anxiety that disturbs cognitive capacities and leads to poor learning results. However, by placing the students in a collaborative context for problem solving, any risk of tension is diminished since students are encouraged to share their individual resources in a non-competitive climate.

Through the number of interactions it engenders and with the proviso of creating a climate that is emotionally secure, teamwork succeeds in maintaining motivation and supporting the learning of cognitive capacities vital to the acquisition of a problem solving process. Each individual is encouraged to discuss the way in which he came to understand the problem, to voice his opinions, provide feedback to others, establish links between various concepts, respect other viewpoints, make decisions and question the suitability of the approach. In certain cases, the students can effectively recognize the difficulties of a colleague more easily than the professor can, and therefore be able to help shed light on the matter. Teamwork and exchanges offer unique opportunities to use a large variety of cognitive capacities that make in-depth learning possible.

In certain training programs, the ability to solve problems in teams is considered an essential professional skill to be developed. As such, it is necessary to acquire problem solving skills not only on an individual level, but also to implement strategies that facilitate the acquisition of skills needed to solve problem cases collectively. This also leads the student to make a gradual entrance into the culture of his future professional practice.

A teaching challenge

Everything we have just seen about problem solving represents a great challenge for professors who are trained and prepared to deliver contents rather than support the acquisition and development of this capacity.

Tasks relating to basic education, the implementation of a teaching approach based on competency and current reflections on the integration of learning bring professors to question their own approaches. Whether it is through a local academic project, a graduate profile specific to individual programs, or a shared concept of competencies, professors will have to decide what role they wish to give problem-based learning in their classroom. Then they will have to identify suitable teaching and learning approaches to support its development.

Research in cognitive psychology and in education confirms that the acquisition of a capacity as complex as problem solving requires time and learning activities directed towards practical exercises in a variety of contexts. This implies the need to consider the teaching of this skill within a program perspective. One single course is not sufficient to allow a student at collegial level to develop such expertise. Nor does a single integration activity inserted at the end of the program appear to be sufficient for teaching the process.

It would also be inappropriate in the comprehensive program assessment, to evaluate the problem-solving capacity of students who have not benefited from a systematic teaching and learning approach enabling them to develop this ability during their education.

We need more collective reflection on how much importance to grant this cognitive capacity within the overall education of a student. It is also necessary to determine the program content linked to its acquisition: types of problems to be selected, knowledge to be used, the procedural model and strategies of problem solving to choose, and metacognitive skills and attitudes to be developed. The methods of teaching and learning most appropriate to the context must also be identified and we must understand how each course will contribute to the development of this problem solving capacity. However, these new orientations will certainly cause the emergence of various types of resistance. This resistance will have to be handled carefully so as to allow for a real change in practices.

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Text 6
Problem solving in electrical engineering

Bernard Legault

In our *Electrical technology and Circuitry* (*Technologie de l'électricité et Circuits)* courses during the past few years, Carlo Buono and I have made it a point to confront students with problems rather than exercises. We know that in the work environment, the technician will have to face real problems. Therefore, from the very start of his education, he must become skilful in dealing with this type of situation. However, we noted that despite our efforts and verbal reinforcements, a large number of students did not possess the maturity or, did not develop a structured method to effectively deal with problem situations. *Therefore, it seems to us, that we must explicitly include such an approach in our teaching to support the transfer of learning in students.*

In the following text we describe in detail our concept of "exercise" and "problem". I accompany this explanation with an example taken from one of the two courses in question. Then I conclude by recommending the approach that we intend to use in the *Electrical technology and Circuitry* (*Technologie de l'électricité et Circuits)* courses beginning next year. You will note that this approach is generalized and can therefore be adapted to various courses as the students advance in their studies.

PROPOSING PROBLEM SITUATIONS TO STUDENTS

Why talk about problems?

As previously mentioned, technicians will face various problems in the work environment: an operator having difficulty using the system correctly will relate this to the technician who must then make a diagnosis and perform some action. Unfortunately in most cases, the operator does not have the competency to make a meaningful assessment of the problem.

What happens is that the technician must process chaotic data given to him and identify what is relevant and what is not. He will then need to formulate an idea of what the problem is, based on his knowledge and experience. Finally, he will take action.

We want to train the technician by having him come face to face with all facets of operation. What could be better then, than to present problem cases that will make him skilled at reacting correctly to this type of situation, from the outset of the training?

The problem cases which we propose are primarily designed to develop in students the ability to transfer theoretical concepts to practical situations that are as close as possible to reality.

Within the framework of our courses, all the situation scenarios, whether they relate to the diagram of a household appliance or an electronic gadget, are oriented towards an analysis of the problem. However, we are also able to develop cases that allow students to complement their analytical ability with a certain laboratory expertise.

How to define a problem?

The definition which follows contains guiding elements. It is certainly not complete nor does it come from any specific theoretical text, but it helps orient our choice.

To us, a problem represents a complex situation in which the student must be able to process the data he receives. Among the overall information, he chooses what is relevant. He must develop the ability to interpret the information and prioritize it in order to make the correct choices relative to the task ahead.

This **new and complex case** must incite him **to find links** with concepts which he knows, or similar applications and situations. The student must then be in a position to **identify missing information** to complete his analysis and **find viable leads** to solve the problem. He then applies the proposed solutions. Finally, the student has to check the relevance and effectiveness of the results he obtains, and be prepared to start the process all over again if it proves erroneous.

How exactly is it used in our courses?

Traditionally, reference manuals describe concepts in a way that takes them out of real contexts. The theory is presented and related exercises are proposed (probably drawn from real contexts but without ever mentioning or identifying them). It is up to the student to learn to recognize them.

Over the years, we developed the following approach (what follows applies mainly to theory and sometimes to the laboratory but in a less organized way): we identify functional models relating to the behaviour of the components or the components themselves, depending on the situation. These models usually relate to elements that are known by the students.

We recommend two types of activities to integrate these models into the analysis of circuitry: exercises and problems:

- *Exercises* involve circuitry without any context like the kind we find in traditional documentation. Their purpose is to help the student become skilful in calculating or recognizing the models through practice.

- *Problems* are complete applications containing the same subject matter as in exercises. However, in this instance, the student must be able to isolate from the entire circuitry, that portion that relates to the question asked. Therefore, we must provide the student with general concepts on the behaviour of circuitry so that he may find his way around.

Which conclusions are we to draw from our experiment?

For the reasons expressed previously, we are convinced that the use of problems is the orientation that must prevail throughout our two programs of studies. This orientation can be experienced differently from one session to the next and from one program to another, but in our view it remains basic. However, we do not teach a structured approach to problem solving. Such conditions have been shown to prevent the students from developing the necessary abilities to solve problems correctly.

The most structured students, usually the most gifted, manage to do well on their own. Moreover, they do well regardless of the teaching context in which they find themselves. However, for a large number of students, this new approach represents a fundamental change. They must adapt to it. *To do this, we must teach them explicitly an approach that allows them to do so, and integrate the latter in the learning objectives of the most appropriate courses*. This is where things stand today.

All in all, teaching the stages of a structured problem-solving approach, beginning in the first year and continuing throughout the remaining years of the program, supports coherence in our programs without negating our educational objectives.

AN APPROACH TO PROBLEM SOLVING IN ELECTRICAL ENGINEERING TECHNOLOGY (EET)

(This second part of the article targets students interested in a more explicit teaching.)

There are two critical moments in the problem solving approach: *the conceptualization of the problem and the resolution of the problem*. Each of these steps is important. However, we noticed that the first stage is often neglected by students who want to carry out the second stage too quickly. Thus, not taking the necessary time to properly *to conceptualize* the problem can sometimes make it very difficult *to solve it* correctly afterwards.

We realize that the approach we are proposing to you here is presented in a structured and linear manner, i.e. one stage after the other. The first two classes will attempt to instruct you and make you skilled in applying it systematically. However, we are also aware that when you face a real problem, the process used is not quite so linear. Nevertheless, if you want to successfully solve a problem, you must go through each stage regardless of the order followed.

The approach that we recommend is relatively general. Even if we are mainly referring to the courses *Electrical technology*, *Circuitry* and *Mastering a control system* in our text, it adapts easily to a variety of contents associated with electrical engineering technologies. So, as you evolve within the program, this approach will become more precise and will adapt itself to the field in which the problem occurs (electronics, automation products, physics or programming). This adaptation does not take anything away from the two fundamental stages connected to problem solving: *the conceptualization of the problem* and *the resolution of the problem*.

The conceptualization of the problem is the key stage in the approach we are proposing. It is that moment in the course when you must: collect relevant information, i.e. useful in the current context; establish a link between this information and what you already know; and mentally trace the steps you must take to successfully solve the problem.

This moment can also allow you to identify the nature of the knowledge or skills which you need to continue your reflection and to successfully carry out the problem resolution.

The resolution of the problem consists in using the tools available to follow the path to resolution, once all the relevant information has been gathered and the path identified. At this stage, it is of primary importance to look back over the progress achieved to ensure we are on track as regards the objective.

The conceptualization of the problem

Gather information

- *Read the problem statement attentively.* Make sure to clearly understand the problem statement. Interpret correctly what is requested.

- *Extract the information contained in the statement.* What do I get from the statement on the context? What are the facts provided? Is there a diagram?

- *Identify clearly what is requested and what is sought.*

Establish links between the problem and what we know

- *Identify **relevant** information in connection with what we seek.* The relevance of information requires good understanding of the statement and the ability to establish links between what one is seeking and what one knows.

- *Organize information so as to establish links.* Here are some operations which can be carried out within this framework; they are not necessarily in order and it is not necessary to carry them all out. On the other hand, all these operations must be written down on paper. **Do not be content with doing them in your mind. Train yourself to write them down.** The majority of these operations enable you to understand the problem from a qualitative perspective before arriving at a quantitative solution.

- draw up a simplified diagram of the learning model
- build a mental or mathematical model
- describe the behaviour of the circuit qualitatively
- identify the principal functions of the circuit
- establish links between the principal functions
- recognize the various parts of a circuit
- redraw it so as to see the circuit differently
- identify entries and exits
- identify the control section and the operating parts
- compare what you know about the problem with similar problems you have already encountered; what are the similarities and the differences? (if the context allows it, use course notes or other references).

- *Identify what is missing or what would be necessary to continue reflecting on the problem.*

Identify a promising lead toward a solution

- *Isolate part of the circuit and redraw the diagram.* In a laboratory setting, determine the steps necessary to carry out and get the expected results.

- *Identify the physical relationships and the equations which govern them.* Identify the ideas, concepts and relationships involved.

- *Identify known and unknown parameters.*

Problem resolution

Follow the path to resolution

- *Choose a problem solving strategy*. Several strategies exist. The suggested path may favour one over another. Below are a few strategies that can prove useful to you depending on the case:

  - Divide the problem into several small problems and solve them separately.

  - Simplify the circuitry by using known concepts and simple models.

  - Use an iterative strategy (trial and error).

  - Collect additional information on a component or a portion of the circuit.

  - Consult an expert for assistance.

- *Use the concepts, notions and/or physical relationships based on the steps identified to find the desired solution.*

- *Identify the equations that are relevant to the resolution of the problem.*

- *Solve the equations.*

- *Obtain a numerical, graphic, software or material solution.* Use all the tools placed at your disposal, whatever they may be.

Self-regulation of the problem solving process

- *Check the validity or the likelihood of the results*. For example, is the order of magnitude of the variables or the physical units probable? Does the physical circuit behave as expected? Does the program effectively achieve what it is designed to?

- *Make a judgement on the results obtained*. If they prove to be non-relevant or unsatisfactory, how it is possible to modify the situation?

- *Return, if necessary, to the actions relative to the conceptualization of the problem*.

Present the results

- *Express the results accurately.* If the results represent physical units, does a unit or a symbol of a unit accompany each of these figures? If it is a graph, does it have a heading, are the axes well-defined, are the size measurements clearly indicated, are the axes easy to interpret? Is the program format suitable for the application?

- *Respect the procedures for presentation and conceptualization.* Be sure to verify again the instructions or correction criteria one by one and comply with them. Consult a methodological guide for the presentation of work in electrical engineering technology. Make sure that the schematic representation of the physical phenomena complies with what is required.

Chapter 5 contents at a glance:

Laurier, Busque, 1998, 'La démarche fonctionnelle de résolution de problèmes', in *Cinq stratégies gagnantes pour l'enseignement des sciences et de la technologie*, Montréal, Chenelière/McGraw-Hill, member of Chenelière Éducation. P. 109-164.

The functional approach to problem solving

- The bases of the strategy

    Conventional notion of problem solving

    Two steps to problem solving

- Stages of a functional approach to problem solving

    Problem types

    The eight stages in a functional approach
    - *Stage no 1: the experience lived*
    - *Stage no 2: identification of the problem*
    - *Stage no 3: the exploration of the environment*
    - *Stage no 4: the definition of the function*
    - *Stage no 5: the search for solutions*
    - *Stage no 6: the choice of ideas*
    - *Stage no 7: the building of the tool*
    - *Stage no 8: using the tool*

    Integration of the heuristic tools
    - *Problem reduction*
    - *External representation*
    - *Analogy*
    - *Regressive reasoning*

- The didactic aspects of a functional approach

    Thee learning process

    The three levels of use of the strategy

- The evaluation and the functional approach

    The formative evaluation
    The summative evaluation

Text 7

A new educational strategy:
The Collective project.

Suzanne Laurin, geography professor at Cégep André-Laurendeau in 1990, describes this strategy in an article entitled *L'apprentissage par projet collectif, ou quand les étudiants se prennent en main...*, taken from volume 4, no 2, of *Pédagogie collégiale*, December 1990 (p. 20-22).

To allow those who want to examine this approach in greater detail in order to implement it quickly and effectively, we have included at the end of text 7 an overview of *L'apprentissage par projets: fondements, demarche et mediation pédagogique du maître dans la construction des savoirs de l'élève*, 2001, Montréal: Chenelière McGraw-Hill, member of Chenelière Éducation, P. 109-164, by **Louise Capra** and **Lucie Arpin**.

Learning through collective projects, or when students take control…

Suzanne Laurin

On May 2nd last year, students at Cégep Andre-Laurendeau, with the assistance of their professor in Sociology of Work, organized a congress called "Intermission in the labour world" *(Entracte sur le monde du travail).*

From 9:00 a.m. to 5:00 p.m., eleven papers were presented by students of the organizing classroom group and by outside guest lecturers asked to speak on various problems connected to the labour world: wage equity, unemployment, the nonsensical side of work, occupational health and safety, changing qualifications and educational requirements, etc. Humorous sketches were presented in between the papers. Moreover, the participants in the congress were able to pick up on-site a collection of the papers produced by the students within the framework of their course.

I attended this congress that raised a number of questions in my mind as I observed the astonishing professionalism of these young people: Where did they get their ideas? How did they manage in less than one session, to organize such a large scale event? What kind of supervision or framework did their professor provide? What does successfully completing this kind of project mean to these young adults?

To discuss it further, I met Catherine Herrera-Turgeon, Lyne Martel, Éric Cimon and Benoît Fortin, students and student-coordinators, and Sylvie Dagenais, their professor. It should be noted that Sylvie is a part-time professor; in the winter trimester of 1990, she taught at two cégeps and assumed additional research responsibilities.

- **S.L.** *Whose idea was it to organize this congress?*
  "It was a crazy idea of Sylvie's", said Éric. "At the start of the course, while discussing evaluation methods, Sylvie suggested we step outside the traditional box and organize a congress on work."
  "We didn't even know what a congress was", said Lyne.
  "And we wondered what it could possibly teach us", added Benoît.

Éric, a leader with broad experience, went for the idea in a big way and his passion for the project was instrumental in convincing the others. The project quickly became a collective one.

"First we had to agree on certain points in class," said Éric. "Everyone had to make a commitment or the project would be canned. It was a class project or nothing at all. Then, Sylvie agreed to free up a period of about one hour during regular class; conversely, the theoretical content of the course was more concentrated". Benoît concurs: "Everyone agreed; we were so strongly motivated, there was no problem. We were very keen."

The event had to be organized outside of course hours, which were 2:00 p.m. to 5:00 p.m. It is noteworthy to point out that the students seldom left the college before 6:30 p.m.

- **S.L**. *Work was your general theme, but you had to properly identify the problem, how did you define it?*

That seems to be a difficult question. They look at each other, somewhat unsure of themselves. Could they be integrating concepts? Sylvie intervenes discreetly: "At the beginning of the course, we discussed the orientation we wanted to give to the congress…" Catherine continues: "Yes! The evolution of work in Québec, then and now: analytical perspectives of the past, present and future."

Nothing less. Everyone laughs because, obviously, it required a great amount of effort on her part. The congress has been over for two weeks now and yet they are still very close to the experience.

Benoît adds: "The name says it all: *Intermission in the labour world*. We wanted to stop working and talk about it together and see where the labour world is going. We do not want to be mere spectators in the labour world. This is why seven students presented papers and not just outside speakers."

Sylvie comes back to the objectives established at the outset. Éric pursues: "We, Sylvie and our team, identified a series of objectives together. Each individual tried to express what he hoped to learn through this experiment. I believe we formulated eleven separate objectives. One of our objectives was *to speak out*, initially in the classroom but then by making outside contacts and also in assembly, during the congress itself… This allowed us to finalize the idea of a congress. Before that, it was rather an abstract concept for most of the students. Last but not least, it was not obvious either that all the tasks were connected to the course contents. For example, does sending a fax transmission have anything to do with the course...?"

- **S.L.** *Precisely. What links were there between the various papers and the theoretical contents of the course on the sociology of work?*

After some hesitation, Catherine re-examines some of the themes: technological changes, working conditions, Taylorism. In the discussion, links are forged and pieces joined together.

S.L. *What stages did you go through to complete your project?*

Sylvie replies: "We started by finding the theme and then the sub-themes. We discussed the contents of the congress at length, why it was being organized, what were our objectives. Then, we tackled the question of money."

They agree. Catherine continues and talks about the budget, the assistance received from Student Services, the Student Association, Teaching Services and the sale of the papers presented at the congress. The total cost: between $700 and $800 only! She also mentions that they tried to finance the entire project but were unsuccessful.

Then, the guest lecturers had to be chosen.

Benoît speaks up: "Sylvie asked us to search through magazines, to keep our eyes peeled, to look among our contacts, and to invite interesting people and people who interest us." Éric continues: "We set up work committees: internal and external relations, publications, publicity, technical support and various activities. Each individual chose his tasks according to his interests, abilities and past experience. We were also very receptive to the abilities of others, which became necessary for the success of the group project. We worked together, the guys and the girls, without any problem."

Moreover we were very sensitive to sexism, said Benoît. The feminization of the texts and our themes, like wage equity and sexism in the workplace, reflected this concern."

- **S.L**. *But there were problems and difficulties...*

Lyne elaborates on the fear she felt initially. "We had never done anything of this magnitude before, except for Éric perhaps. I did not like to call people, all these steps frightened me. I was scared of failing, of being refused. Yet, despite all this, I was exceedingly curious as to the final outcome."

Catherine adds: "At the start, it was Éric who did everything. We hardly lifted a finger. It was not a concrete project. The timetable was not clear for us. In February, the scheduled date of May 2nd appeared very remote. There was no hurry. We worked within committees but did not yet feel the guiding theme or idea that linked everything together."

"It was Sylvie who shook us up," says Benoît. "She was quick to reprimand us. She told us that the congress would take place based solely on our interest. If not, we could go back to more traditional work. She spoke to us about solidarity and mobilization. She encouraged us to complete our tasks and assume our responsibility, to try and go beyond our limitations and maintain a winning attitude. We could do it, but we had to work at it. As it turns out, these are fundamental values in life and in the workplace. We got back on track and afterwards everything starting falling into place."

Sylvie stresses the importance of a fundamental aspect: "Each student had to undertake his own preparation for the congress by writing a sociological essay on a subject of his choice connected to the general theme. For some, this work would serve as the basis for their oral presentation, but, since all the essays were published afterwards even those who did not speak at the congress were rewarded by being included in the publication."

- **S.L.** *If you had to summarize what you learned through this project, what would you say?*

The eyes light up and the answers start flowing:

- "My professor in political science congratulated me on quality of my communication. That really pleased me! It was very rewarding."
- "We learned to publicize ourselves by going outside the cégep."
- "We learned about the work environment by going on-site to make contacts. We succeeded in mobilizing people that we believed were untouchable, like Pauline Marois for example, and we realized that they were people just like us."
- "I learned self-confidence, to express myself orally and in writing. I learned how to initiate a personal endeavour that exceeds the framework of my course."
- "There was the feeling that we were able to do something important, to show the world and the college."
- "We developed strong bonds with others in the classroom. Now we speak more freely outside of the classroom because we achieved something together."
- "We learned many new things, both in theory and in practice."

The one regret they have about the whole experience is the weak participation of the academic environment. Éric explains: “We were disappointed that courses in the Humanities Department were not officially cancelled on that day. It goes against the laboratory’s objectives, in that professors talk of interdisciplinary exchanges when inviting students to carry out their projects. What we did was a genuine humanities laboratory! We varied the conference themes deliberately to touch the greatest possible number or courses, but all to no avail.”

Sylvie disagrees: “But YOU learned a lot and that was the goal!”

Benoît continues: “Some teachers told me “This doesn’t apply to my course.” Another commented “You are taking my course time to work on this project.” I think that my study time as a student belongs to me! I am not taking time away from the teacher.”

They seem disappointed and very critical of this situation. Éric continues: “Perhaps professors are sometimes jealous of the success of others, to see that we were more passionate about other course than theirs; perhaps they felt threatened in their own functioning.

A project such as this one calls many things into question… ”

To see them on May 2nd, getting along so well together, so happy to be at the cégep, truly in charge of their own destiny... for one day, it was something to be proud of.

When we think of it…

“A project such as this calls many things into question… ” This project, which we could describe as *organic* inasmuch as it was the result of a particular chemistry between a professor and his students, their sense of risk-taking and desire for a teaching adventure, has an undeniable and provocative effect.

In his work *Pourquoi des professeurs? (Why professors?)* , George Gusdorf wrote:

“It should be admitted that true learning mocks learning. Essential education works through teaching; but learning happens, when necessary, despite teaching or without it. The reality of schedules, programs and handbooks, carefully selected by ministerial technocrats, is but a decoy…; its true purpose (use of time) is to preclude accidental and fortuitous meetings, dialogue between the professor and his disciple, i.e. the confrontation of each individual with himself. The years of schooling pass, and we forget the rule of three, French history dates and the classification of vertebrates. What remains is the ever slow and difficult awareness and recognition of a personality.[1]”

Here is perhaps the essence that we skip over too easily in our discussions on programs and their reform! Indeed, what could be more difficult than this self-confrontation that the professor/student relationship urges us to do? The truth about this project is simply and

[1]GUSDORF, George, *Pourquoi des professeurs?* Petite Bibliothèque Payot,, 1963, p. 46

emphatically that: in a cégep classroom, on the departmental sidelines and beyond bureaucratic schooling, a group of students placed themselves at the heart of their own learning.

They energetically took control of their study time and also of their own space[2]. They appropriated *their* cégep and connected it to the external world through their own initiative. They understood that being a student is not a state but rather an action.

Or course, such projects are not always possible. But it is really comforting and stimulating to *know they do come along from time to time.*

[2] Many discovered what is behind-the-scenes at their cégep by putting up decorations for the congress in the auditorium, by going around to all the classrooms and by dealing with the administration.

Overview of table of contents of taken from:

Lucie Arpin and Louise Capra, 2001, in *L'apprentissage par projets : fondements, démarche et médiation pédagogique du maître dans la construction des savoirs de l'élève*, Montréal, Chenelière/McGraw-Hill, member of Chenelière Éducation. 270 p.

Introduction
Project based learning: its base, approaches

Part 1: From Project to Project based learning
Chapter 1: The project is a preferred path to learning

The project and its influence in our lives. Why do projects transport us and motivate us? How do projects make it possible for us to come into our own? The project and its precursors in education. Project based learning, our teaching choice. Our definition of project based learning. Characteristics of projects in our teaching.

Chapter 2: Educational bases of project based learning

The influence of cognitive psychology. The socio constructivist learning movement. Conscious reflection. What operations must we undertake? Mediation by the teacher and the construction of learning by the student. What is pedagogical mediation? Our concept of mediation in project based learning. Pedagogical mediation and the learning process of students. Pedagogical mediation in the unfolding of projects.

Chapter 3: A unifying approach

Links to strategic teaching. Links to cooperative learning. Links to mental management. Where does mental management come in as regards project based learning? Links to problem solving. The ICT and project based learning. What help will ICT bring to learning? Advantages and disadvantages of using ICT? The undeniable support of ICT in project based learning. An example of a unifying project.

Part 2: The educational process in project based learning

Chapter 4: linking a collective project to the life experience of students

I have a goal: to arouse motivation and the participation of the students in their learning. To be attentive to the students' ideas, tastes and interests. To choose the field of study together with the students. How much time can be allotted for a collective project? What learning will take place for students within the project? Which disciplines are complementary to the selected field of study? Is it necessary to integrate all the disciplines and all the contents of the study program?
I know why: to support the construction of learning.

I know how: cognitive tools, resources, strategies and methods of evaluation likely to support student learning. What situation scenarios could arouse the students' interest and their desire to ask questions? Which resources would be useful to enrich the environment and to generate questions? Which intellectual tools are necessary to the project? What evaluation methods should I privilege? How does daily evaluation play out in project based learning? Can the portfolio accompany the student in his learning?

Chapter 5: The interaction of the teacher with his students

<u>Phase 1</u>: “We are getting ready to learn,” this is the elaboration of the collective project

Stage 1: exploration of the field of study. Stage 2: creation of groups and choice of integration theme. Stage 3: specification of interests and of questions to be asked Stage 4: identification of the learning connected to cognitive, personal and social development.

<u>Phase 2</u>: “We construct our learning,” this is the realization of personal projects

Stage 1: project creation. Stage 2: realization of the students’ personal projects Stage 3: to accompany the students throughout the realization of the projects.

<u>Phase 3</u>: “We integrate our learning,” this is the communication and sharing of learning

Stage 1: presentation of discoveries and what has been learned. Stage 2: enrichment of the collective project. Stage 3: realization of a collective project.

Part 3: Application of project based learning in class

Chapter 6: The first phase of the approach: the preparation for experiencing a collective project

The choice of a project with meaning and learning potential. Which competencies will students be able to develop through this project? Fields of learning connected to the project. How to help the students construct their learning. Cognitive tools, resources, strategies and methods of evaluation. The logbook. The training book. What evaluation method to favour?

Chapter 7: The second phase of the approach: the interaction of the professor with the students.

The elaboration stage of the project for Québec. The formation of the groups. The graphic organization of groups. Which integrating theme could drive our project throughout the entire year? Identification of interests and questions. Identification of the learning with the students. The stage of accomplishing personal projects. The creation of students’ personal projects. To help a student in difficulty integrate in a team: interaction between peers and mediation. How to arrange the environment to support the projects? The students are ready to share their questions. The realization of personal projects. How will we present our learning? The communication stage. First presentation: life of the Patriots in 1837. Second presentation: old objects and barter. Third presentation: an experiment on plants. Reinvestment of the learning and enrichment of the collective project. The conclusion of our “I live in Québec” project.

Part 4: To be an ongoing professional development project

Chapter 8: Teachers share their experimentations

A garden at the school entrance (Marc Williams and Jeannita Sonier, Grade 8)
Catastrophes in the world (Jeanne Godin, Grade 8)
A project on the French language at the secondary level (Sylvette Thériault, Grade 11 & 12)
The “Castles” project (Claudine Bellavance, preschool education 5 years old)
The project “Learning together, big and small” (Louise Lavoie, Grade 1)
A collective project suggested by the students (Brigitte Gagnon, Grade 3)

Chapter 9: The progressive acquisition of the project based learning approach

To question our pedagogical knowledge. To understand the learning process so as to accompany, through mediation, the student who is learning. To exchange and interact with colleagues.

Conclusion

Bibliography

Portfolio of teaching resources

Texts 8 and 9

Two approaches that integrate several new educational strategies:

The Célestin Freinet approach

and

Mastery Learning

Jacques Belleau, education adviser with cégep Lévis-Lauzon in 1999, presents the Célestin Freinet approach in text 8. This text is taken from volume 13, no 1, of *Pédagogie collégiale*, October 1999 (pages 27-33). In 1999, the author also held the title of president of the Implementation/Development Committee of the Yves-Prévost Optional School and coordinator of activities for the Freinet option on the secondary-level Committee.

Pierre Matteau in 1988 was part of the Research-Action group of PERFORMA at Université de Sherbrooke: he presents Mastery Learning in text 9, taken from volume 2, no 1, of *Pédagogie collégiale*, October 1988 (pages 14-17).

Text 8

An alternative teaching approach at collegial level: The Freinet approach

Jacques Belleau

For several years now a number of new teaching movements have been challenging the collegial environment. This is how, bit by bit, Mastery Learning, strategic teaching and, more recently, cooperative approaches to teaching have attracted greater attention. We have also expressed concern with the teaching of attitudes, support for academic success and an inter-cultural approach to education. This quest is symptomatic, for all of us, of our dissatisfaction with our teaching practices. Interestingly, these educational movements have one thing in common; they give the student a larger role to play. However, beyond curiosity and some training activities, there have been few repercussions in actual teaching practices. This is partly due to the difficulty of calling into question well-rooted ways of doing things. Given the new requirements to be met with educational reform, program revision provides an opportunity to carry out these changes.

It is interesting to note that these North-American movements have their counterparts in Europe. This text presents the Freinet pedagogy[1] which, like the other movements mentioned above, promotes certain significant changes in our classrooms.

The meeting

Célestin Freinet entered my life randomly thanks to a small advertising pamphlet put out by a public primary school[2] which had embraced his teaching approach for the last seventeen years. Through my own involvement with this school in the following years, I deepened my knowledge of this dynamic pedagogy. Eventually, the Freinet approach was implemented at secondary level. A first in Québec, and undoubtedly, the first known application of its kind. In fact, it was during work on the implementation project that I commented jokingly to the members of the team I was coordinating, that one day we would see a Freinet cégep. This joke turned out to be more prophetic than anticipated and after further reflection I realized that there was indeed a highly interesting potential to be explored here. This text is a synthesis of my reflection on the matter.

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[1] This is a true question of education as Freinet identifies a value system that generates a structured approach and tools that accompany the student along the way.

[2] The Yves-Prévost "optional school" is part of the Commission scolaire des Premières Seigneuries. It is located in Beauport and accommodates more than three hundred students at various levels.

Elements of understanding in the Freinet approach

A person's work is often indistinguishable from their experience in life. This was the case for Célestin Freinet. Born in France in 1896 in a rural environment, he had to divide his childhood between work in the fields and work in school. School appeared to him as an environment with abstract methods that were unrelated to his real life; an unimportant interruption in his daily existence. However, during World War I he was gas-bombed and suffered damage to his voice, which forced him to adapt his teaching style to compensate for this handicap.

Influenced by the social thinking of Marx, Engels and Lenin, he imagined a school closer to the realities of his time. For him, teaching needed to continuously adapt itself to its environment. As he saw it, the schools in his day tended too often to neglect the contributions of technology in favour of the lecture format, recitation, and memorization and school manuals. This academic environment was focused on programs and subject matter taught by an all-knowing professor[3]. The student had to submit to it. Freinet proposed a schooling system integrated into daily life that would give meaning to the learning process. It was based on the creative spirit of the student, his desire to discover, learn, communicate and express himself. Freinet introduced modern technology in the classroom; he used printing for example, to facilitate adaptation to the environment. He redefined the role of the professor who now took up his position at the centre of the group and functioned as a helper, or a guide. The classroom became a form of society[4] that organized itself.

The new connections created in the triangular dynamics of teaching relationships are based on student accountability for his own learning and that of the group; on student autonomy in managing their own learning activities and time; on a natural (experimental trial and error) and personalized approach to learning; and, on an openness to life that gives meaning to what is learned. In such a context, making mistakes is not pathological but rather a way to progress. A mistake is normal;

[3] School today is not very different. It is undoubtedly the only institution that compares to televised quiz games in that it is those who possess the knowledge who ask the questions.

[4] It is to be noted that Freinet speaks of "society" rather than "community". A society brings together people who must work together and respect one another; contrary to a community where people choose to participate. This facilitates the creation of emotional ties between members. A classroom brings together people on a more or less arbitrary basis and, for a predetermined period of time: in other words, it creates a society.

when we penalize an error we introduce a bias in learning: that of insecurity[5].

Freinet's pedagogy gives a preponderant role to the way in which we learn. Experimental trial and error[6] is what most closely resembles natural learning. Before the invention of schools, we learned through observation and repetition[7]. This is how children learn. Yet, from the moment they enter school, this type of learning is left on the shelf. Freinet, on the other hand, maintains and adapts this natural way of learning. He believes that the student learns through answers to his questions and by solving problems that he meets along the way. In such a context, knowledge and learning are answers to individual concerns, a powerful source of intrinsic motivation. Knowledge becomes a tool that we can learn to identify and use when necessary. The professor remains responsible for the programs, but he is also responsible for introducing them at the opportune moment. Learning cannot be artificially segmented. Various fields of knowledge interpenetrate and this facilitates a real integration that makes it possible for the student to answer the increasingly complex questions facing him.

The development of an independent and free citizen is the goal of the Freinet system. Freedom is defined and achieved by the capacity to solve problems that occur and the ability to communicate. Independence is more a way of life than a goal (who can boast of being truly independent?). Becoming independent requires the gradual acquisition of a sense of responsibility. Responsibilities are devolved upon the student as soon as he demonstrates the capacity to assume them.

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[5] To learn implies a personal involvement unhindered by insecurity that causes us to limit our risk taking. We generally find out quickly what we don't know, that is, we make mistakes and learn by trial and error. However, evaluations have become a classroom management tool, a way to motivate rather than coach the student, a certificate of validation.

[6] I often observed that when a person acquires a consumer good, they seldom take the time to read the instruction manual. The object will be connected, turned on and the manual will only be consulted when a problem arises. This is an example of experimental trial and error. The academic system encourages us to read the instruction manual, teaches us how to press a button or read a dial without giving any meaning to these actions. When it comes time to carry out the action, there is no interest in doing it.

[7] When the student learns gradually and intuitively using the knowledge of another student, he is learning vicariously. For example, presenting the work of another student as a model is a way of putting in place the necessary elements of the process. However, when a student takes the initiative of seeking out the clues to resolve a situation and move forward, he is accused of plagiarism. Strangely enough, it is the same situation in both cases, the only difference being that the professor authorizes it in one case but not in the other. What has been forgotten here is that the student is in a learning process, and that the most natural form of learning is precisely this kind of observation. What distorts reality further is the omnipresence of the evaluation which intervenes before the learning is even completed. (For more on this subject, refer to the work of Maurice Reuchlin.)

The Freinet pedagogical system is embodied in a variety of teaching tools. Current practices include the following:

FREE EXPRESSION: free drawing, debate, free-form text, musical composition, bodily expression, theatrical expression, technical or audio-visual creation, mathematical creation, computer science.

COMMUNICATION TECHNIQUES: inter-school correspondence, school journal, composition and printing, radio techniques, student presentations, exchange trips.

TECHNIQUES FOR ANALYZING THE ENVIRONMENT: Question box, class visits, personal investigation, academic background and culture, scientific experimentation, critical review of journals, study of economic phenomena.

TECHNIQUES FOR THE INDIVIDUALIZATION OF WORK: self-corrective tools, documentation.

TECHNIQUES FOR ORGANIZATING A COOPERATIVE STRUCTURE[8] : individual work program, evaluation, diplomas, structure of cooperative life, organization of various work-related tasks, work planning.

A few years before his death in 1966, Freinet summarized his thoughts in the form of a pedagogical code of sorts. These pedagogical invariants[9] are the following.

The nature of a child

1. A child’s nature is the same as ours.
2. To be bigger does not necessarily mean to be above others.
3. The in-school behaviour of a child is a function of his physiological, organic and constitutional state.

The reactions of a child

[8] The Yves-Prévost optional school introduced the multi-level class as one of the tools of cooperative life. Born out of necessity, this organizational mode became one of the important elements for implementing the Freinet approach. It is worth noting that the new programs at elementary level which will be gradually implemented beginning in 2000, distribute knowledge acquisition over two-year cycles: acquisition and deepening. Multi-level classes favour this learning mode.

[9] A commentary on each or these invariants can be found in the work by Freinet: Pour l'école du Peuple. Guide pratique pour l'organisation matérielle, technique et pédagogique de l'école populaire, Paris, Maspero, Petite collection, n° 51, 1969, p. 137

4. No one – neither child nor adult – likes to be ordered about.
5. No one likes to fall into line with the others, because falling into line means passively obeying an external command.
6. No one likes to be obliged to do a certain work, even if the work does not particularly displease them. It is the obligation to do so that has a paralyzing effect.
7. Each individual likes to choose his own work, even if this choice is not to his best advantage.

8. No one likes to work for nothing, or act like an automaton, i.e. do things or submit to thinking that is incorporated into mechanical operations in which he does not participate.
9. Work must be motivating.

Work that sheds light on school

10. No more scholasticism[10]. Every individual wants to succeed. Failure is inhibiting, a destroyer of momentum and enthusiasm. What comes naturally to the child is not play, but work.

Educational techniques

11. The normal pathway to acquisition is not observation, explanation and demonstration, which are essential to school processes, but rather experimental trial and error, a natural and universal learning approach.
12. Memory, so important in school, is only valid and useful when it is integrated into experimental trial and error, when it really serves life.
13. Acquisitions are not made, as some believe, through the study of rules and laws, but through personal experience. To study rules and laws first, be they for English, the arts, mathematics or sciences, is to place the cart before the horse.
14. Intelligence is not, as scholasticism teaches, a specific closed-circuit faculty that functions independently of the other vital elements that make up an individual.
15. Schooling cultivates one abstract form of intelligence that acts through the use of words and ideas set in memory, which are often out of touch with reality.
16. The child does not like to learn a lesson *ex cathedra (from the sanctity of the pulpit)*.
17. The child does not tire of doing work that relates to his life, work which is meaningful to him.
18. No one, neither child nor adult, likes control and sanctioning which are always viewed as an attack on personal dignity, especially when done in public.
19. School marks and grading are always in error.

[10] We are not referring here to the philosophical aspect but rather to the dogmatic principles of school.

20. Speak as little as possible.
21. Children do not like work that they must accomplish like a flock of sheep and to which their individual nature must bend. A child likes individual work or teamwork within a cooperative community.
22. Order and discipline are necessary in the classroom.
23. Punishments are always wrong. They are humiliating for everyone and never achieve the desired result. They are at best a last-resort solution.
24. The new approach in schools presupposes academic cooperation, i.e. self-management by the users, educator included, of school life and work.
25. Overloading classrooms is always a teaching mistake.
26. The environment of large academic complexes leads to the anonymity of the professor and the student; as a result, these structures are always an error and an obstacle.
27. The democracy of tomorrow is taught through democracy at school. An authoritative regime at school cannot be a proper training ground for democratic citizens.
28. Education can only be done in dignity. Children are to be respected and they, in turn, must respect their professor. This is one of the first conditions for the restoration of the school environment.
29. Opposition, which is a pedagogical reaction, is a component of social and political reaction and is also an invariant with which we must deal, since we cannot avoid it or correct it ourselves.
30. In concluding, we would like to mention the one invariant that justifies all our trial-and-error actions: an optimistic attitude towards life.

The above list provides an overview of the foundations, components and elements of the pedagogical principles of Célestin Freinet. His approach merits more elaboration but we are limited by space and the subject matter of this document. However, we felt the need to list these elements in order to grasp the general guidelines and reflect on the pedagogy of Freinet at the collegial level.

Freinet at the collegial level?

Why not? What part of his approach could not be implemented? It would require adaptation and a re-examination of the underlying meaning, without losing sight of the spirit of the approach. At this point, before proceeding any further, we would like to specify why we should embrace this educational orientation.

In my role as education adviser in a medium-size collegial establishment, I am called upon to support teachers who want to connect with their students but don't always succeed. Our obsession with programs prevents us from establishing, within our course framework, a hierarchy of learning, as if all learning carried the same weight. Within a framework of program evaluations, I observe cases where it is difficult, if not impossible to acquire the competencies and integrate the learning. I also note that the programs are, more often than not, a sum of courses that have little or no inter-connection. It appears that the components of general and specialized education are two solitudes, unaware of each other's existence. I also note that our concept of programs tends to make meaningless any notion of program approach. This being said, what could be done? My initial search for solutions was instrument- oriented. Then, I realized this was not enough. I needed to find a more global and systemic approach. From this perspective, it is logical to see the Freinet system as the wave of the future.

- **Elements of a Freinet pedagogical framework at collegial level**

Meaningful learning

Education integrated into daily living gives meaning to what is learned. This is a fundamental pedagogical principle. To begin with, this means that we should illustrate concepts using everyday situations i.e., concrete situations that carry meaning. By doing this, we give students pathways for transfers and elements which connect them personally to a project. Secondly, it is important to give meaning to learning by linking it to the preoccupations of students if we wish to connect with them. We must put aside theoretical, invariant and perfect examples. They are too often disconnected from real life that must take into account many factors that turn a simple situation or equation into a complex one. Nobody is fooled by these perfect examples and they contribute to the de-motivation of learners who feel they are wasting their time. This is not to say that such examples do not have a role to play; as in all things, it is the abuse of such illustrations that make them difficult to digest.

A discarnate, unstructured and fragmented approach does not support integration because it is removed from real life, does not resemble it and, consequently, does not appear relevant to the participants. One of the conditions for successful learning is attraction. When we destabilize and capture the students' attention, we lay the groundwork in which his learning will take root.

Fundamental needs

Every student has the desire to discover, learn, communicate and express himself. It is up to the professor to support and make room for the expression of these fundamental needs. It is easy, even flattering, to display one's higher knowledge. It precludes having to create learning situations that galvanize students into action, making them players and not merely spectators in the learning process. This situation reversal is not only necessary but, within an educational approach based on competencies, a determining factor in student success.

To learn through discovery means to encourage questions from students and to favour experimental trial and error. To communicate and to express oneself means to learn how to ask questions, share information and transmit results. It is, in actuality, a matter of learning a scientific approach based on personal experience.

Modern technology

To enable students to adapt to the future, the introduction of modern technology in class has become an unavoidable reality. We may be opposed to a close proximity between the academic environment and the labour market, but, the education offered at collegial level must allow students to familiarize themselves with the tools that they will use in the labour market. Computers, machine-tools, communication and production tools are all present in our laboratories. This is one of the cégep successes we can be proud of. However, the way we use these tools raises questions. Beyond teaching the basic training needed for proper and secure use, we tend to make our laboratory sessions an extension of theoretical lessons. And, in doing so, we do not always take advantage of the exceptional learning opportunities they represent. We could propose more significant and meaningful learning to the students. We could also examine the usual learning sequence in which laboratory activities generally follow theoretical sessions. Wouldn't the opposite be more interesting for the student and help him better understand?

The role of the professor

The professor is physically in the centre of his group and serves as a resource person or a guide. The meaning is clear, the teacher is integrated into the group, he is available to answer questions and participate in discussions. He places himself within reach of his students, but without decreasing his status or lowering his level. His requirements remain the same. In addition to the dynamic advantages of this positioning, it has also become a necessity due to the learning revolution brought about by the Internet. Access to learning is no longer limited to the library. Access is more far-reaching, dynamic and is in constant growth. This learning revolution changes the role of the professor who is no longer "the" source of knowledge. He must be humble enough to acknowledge his limitations yet be part of a permanent learning process. By doing this, he is better able to understand the students (in discovery, learning, communication and self-expression); and he also covers an indispensable aspect of the labour market: the demand for continuously updated knowledge.

The classroom becomes a society which organizes itself to achieve its goals. The professor is no longer the all-knowing master. He belongs to the group and like other members, has obligations to respect and objectives to reach. The student becomes a member of a society with rules and obligations that are understood and shared by all.

Feasibility

How can we individualize learning when we have to meet more than one hundred students per session, respect their individual learning rates and offer meaningful learning activities, while modifying our role as professor? Sound utopian? Not so. Freinet is simply proposing a fundamental modification of our program designs. As long as we maintain our current vision on courses and specialization, all that has been mentioned above will remain wishful thinking. But when we stop to think about it seriously, when we take the time to imagine the integration of competencies in a given academic cycle, to acknowledge that learning requires the elaboration of problem situations under the responsibility of a team of professors, and when we believe that it is possible to do things differently and still achieve our objectives, then the dream becomes feasible.

The Freinet tools at collegial level: a short overview

Freedom of expression

Among the preferred tools those who like to promote freedom of expression, the most adapted to collegial level are: the debate, the freeform text and various other forms of creative activity. The debate is already exploited as a tool within the framework of several courses. We should adapt this tool to all available courses. All we need is a bit of imagination to make it work. The freeform text is much more difficult to adapt to all disciplines. A personal journal could be an example of a freeform text, but we would have to limit constraints so as to encourage the student to reflect on his learning. In certain cases, for example as part of general courses or in modern language courses, it is possible to implement the freeform text. It is however creative production that offers the greatest number of possibilities at collegial level. A creation is an object (a real or illustrated object) with specific meaning for its author. This object combines homogeneous or heterogeneous (even disparate) elements. The value here is the analysis work done on the created object itself. It is the opportunity to name the components, to re-examine their utility, to connect them, to identify similar or substitution elements, to take a closer look at conceptual aspects, etc. Altogether, the object created becomes an exceptional integration tool.

Communication techniques

We are all sufficiently familiar with presentations to avoid discussing them here. School correspondence could generate a certain interest, but it would be more advantageous to develop a school journal. For all courses, this could be an interesting tool which would allow a group of students in a given program to highlight their work and distribute it within the academic environment, the labour market, secondary schools, even to parents who are eager to know how their adolescents are doing in college. Student exchange programs remain a very interesting tool but require, within the collegial context, organizational resources which we do not have.

Techniques for analyzing the environment

All the tools in this group are found at collegial level, some more widespread than others. For instance, the question box is almost a forgotten tool. Yet, we know that many students hesitate to ask questions in class for fear of being judged or ridiculed. In this case, the question box is an alternative worth exploiting. Professors would not have to answer these questions in class. Students could be asked to answer the questions individually, or in teams, within the framework of a learning activity and then to collate their answers in a journal that would belong to the whole class and could be published once a month (three journals per session). This is a powerful tool for reviewing subject matter both individually and collectively. Answering questions not only requires valid answers, it also demands legible and comprehensive writing that references concepts and knowledge. This method could also prove successful at reducing the burden of corrections that overwhelms many professors.

Techniques for the individualization of work

The Freinet approach recommends the individualization of work for each student since they do not share the same learning rates, prior knowledge, strengths and weaknesses. Our first mistake is to take for granted the homogeneity of groups on the cognitive level. At first glance, this approach seems to increase the teacher's workload. However, this is not the case. Individualization does not mean the absence of collective work when it is required, for example, for the presentation of an idea or a concept. Rather, individualization means that each student has his own work plan resulting from a diagnosis. He works alone or in a team to acquire the competency prescribed by the course. He works alone to acquire learning that corresponds to his level of knowledge and learning rate, and within a team for integration purposes. Here, teamwork takes on its true meaning and can no longer be called just a way for the professor to lighten his workload by discharging some of his responsibilities. From a labour market perspective, it is also a reality that cannot be overlooked or circumvented. In the real world, people must learn how to work within a team.

The use of self-corrective exercises is already practiced in several disciplines. This technique needs to be developed and standardized. At collegial level, there are advantages in developing and exploiting problem-based learning, using both simple and more complex problems. Within this approach, the student is responsible for his own learning, with the freedom to use documentation available at the college, in his environment or taken from the Internet.

Organizational and cooperative living techniques

The organization of the classroom follows rules of behaviour to which all must adhere. Too often however, we impose parameters without recognizing that we are dealing with young adults who need to understand rules in order to respect them. The frustration felt by professors over non-compliance to the 'basic rules', is a negative element that can hinder a learning relationship. So, when we take the time at the beginning of the session to discuss the course plan as well as the rules of participation, valuable time is saved by clarifying the expectations of each individual.

The individualization process begins with the elaboration of an individual work plan developed jointly by the professor and the student. The plan acts as a contract, in effect, and allows for the planning of work activities over a given period of time. Evaluations will be present throughout the process and at the end of the session. It is agreed that evaluations are not an end in themselves but rather learning tools. We are referring here to formative evaluations which are meaningful in providing coaching for the student along the learning path. As concerns the summative evaluation, learning is successfully integrated only when the student is able to explain and make use of the acquired competency, not mechanically but consciously.

The challenges of implementing the Freinet pedagogy at collegial level

Current conditions are favourable for its emergence: programs are being revised based on competencies. Learning activities are being defined locally. Generalized education is moving closer to specialized education. The new regulations on student curricula in DEC programs (Règlement sur le régime des études collégiales) call for work-related practices in the programs as well as new methods of evaluation. As we approach the dawn of a learning revolution, the integration of learning becomes a necessity from both a competency and a program standpoint. We are being urged to change and the opportunity to do so is at hand.

Students themselves differ widely when it comes to learning. We are astonished when we see young people give up on sciences that we insist on teaching Problem is, it is not teaching that students need but someone to coach them along the path leading to science and knowledge. As long as we maintain barriers between our disciplines and as long as we do not create educational teams, we will be unable to help our students acquire, integrate and learn how to learn new knowledge.

The Freinet pedagogy places the student front and centre, thus altering our perception of education by making the student the principal player in his learning.

The questions raised by this teaching approach are fundamental as concerns the evaluation of learning. Are we willing to change our way of thinking to work in teams? Are we willing to sacrifice a little of this precious academic freedom[11]?

Some will say that this way of thinking is but youthful enthusiasm, blind faith, or a visionary's quest. I am fully aware of these perceptions and have no illusions as to the impact of my reflections. They demand a considerable involvement and modification of practices, so even if only a few people at the collegial level embark on this path of action, I will have achieved my goal.

I believe that the Freinet pedagogy is feasible at collegial level. Our current framework is both rigid (the session) and flexible (the program) and we already use several of Freinet's tools. All that remains is to standardize the whole.

Bibliography

The Institut coopératif de l'école moderne (ICEM) founded by Célestin Freinet is the focal centre of Freinet educators and offers various examples of the contemporary expression of Freinet pedagogy. Many websites provide multiple instructions and examples of the Freinet pedagogy, in particular the website of the ICEM (http://freinet.org)

Here is an incomplete list of publications of Célestin Freinet for those who wish to study his approach in greater depth.

FREINET, Célestin, *Essai de psychologie sensible 1: Acquisition des techniques de vie constructives*, Neuchâtel, Delachaux and Niestlé, 1971.
FREINET, Célestin, *Essai de psychologie sensible 2: Rééducation des techniques de vie ersatz*, Neuchâtel, Delachaux and Niestlé, 1971.
FREINET, Célestin, *La méthode naturelle 1: l'apprentissage de la langue*, Neuchâtel, Delachaux and Niestlé, 1969.
FREINET, Célestin, *La méthode naturelle 2: l'apprentissage du dessin*, Neuchâtel, Delachaux and Niestlé, 1969.
FREINET, Célestin, *Les dits de Mathieu*, Neuchâtel, Delachaux and Niestlé, 1978.
FREINET, Célestin, *Oeuvres pédagogiques 1*, Paris, Seuil, 1996.
FREINET, Célestin, *Oeuvres pédagogiques 2*, Paris, Seuil, 1996.
FREINET, Célestin, *Pour l'école du peuple*, Paris, Maspero, 1969. (This last work is a synthesis and an excellent introduction to the Freinet pedagogy.)

[11] It should be understood that we are not referring here to academic freedom as a guarantor of the expression of a plurality of ideas, but rather to the pretence that isolates each individual and limits his interactions and his accountability within the department, and the program.

Text 9
Mastery Learning: an integrating strategy
Pierre Matteau

Mastery Learning is an educational strategy known for a number of years by psycho-pedagogues that calls into play the fundamental rules of common sense. The strategy incorporates: the identification of cognitive and emotional prerequisites to learning; the verification of knowledge acquired by students relative to these prerequisites; a teaching plan based on recognized student deficiencies; learning evaluations done as frequently as possible; feedback and corrective teaching provided to the students. All teachers involved will acknowledge the necessity of this series of activities.

In this article, we will outline the history of *Mastery Learning* and identify key characteristics of the approach. We will also show that as a strategy, it integrates practices currently used by a majority of teachers but in a disconnected manner. At the same time, we will relate how a small group of educational advisers at cégeps came to be interested in *Mastery Learning*. We will also see that *Mastery Learning* aroused keen interest among teachers who tried it and in students who, thanks to it, developed a new passion for studies.

History of Mastery Learning

Professors have always sought teaching methods that bear fruit and allow their students to succeed in acquiring the learning covered by their courses.

This optimistic outlook according to which all students can acquire the learning presented to them can be traced back to Coménius, Pestalozzi and Herbart[1]. Much later, it was Benjamin S. Bloom[2] of the University of Chicago, who was to place this global teaching strategy, also called "Mastery Learning", at the centre of his teaching method. Mastery Learning is a concept that targets adequate mastery of a proposed learning. Certain French-speaking authors have used the term "Assured Learning", which to our mind, could mean something other than the mastery of targeted skills.

It is however John B. Carroll, in an article entitled A Model for School Learning[3], who re-launched the debate in 1963, in defending his thesis on student aptitudes. According to him, the ability of students to master a concept depends largely on the time allocated to learn and how they use this time. Time spent learning is also related to the students' determination

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[1] COMÉNIUS: Latin name of JAN AMOS KOMENSKI (1600-1670); PESTALOZZI, JEAN-H. (1746-1827); HERBART, JEAN-F. (1776-1841). These three author are quoted in BLOOM, BENJAMIN S., *Caractéristiques individuelles et apprentissage scolaire*, Paris, Nathan, 1979; and in GUSKEY, T., *Implementing Mastery Learning*, Kentucky Univ., Belmont (Cal.), Wadsworth Publishing Co., 1987.

[2] BLOOM, BENJAMIN S., *op. cit.*

[3] CARROLL, J.B., A Model for School Learning, *Teacher College Record*, 64, pp. 723-733.

and their perseverance vis-à-vis the learning. In addition to these factors, a student's degree of learning, according to Carroll, is a function of the quality of teaching, the student's interest for the subject matter and his ability to understand the teaching.

In our opinion, this summarizes the elements that influence learning at school, elements that should guide our efforts in planning learning activities. We will return to this point later.

When Bloom, who had always been interested in individual learning differences, turned his attention to the approach proposed by Carroll, he began by observing what occurred in a regular classroom. He reached the conclusion, among others, that approximately 10 to 20% of students in any given group achieved mastery of the subject taught by the professor. He noted that as the group progressed from one learning block to the next, there was an increase in the number of students unable to acquire the learning.

Driven by a desire to see more students able to master the various concepts and skills, Bloom developed his theory of Mastery Learning. Based on the premise that all students should be able to master learning that is proposed to them, Bloom develop a teaching strategy that would allow a greater number of students to achieve success and thus reach mastery. Moreover, based on the belief that teaching should be pursued in groups, for all kinds of reasons, he built a teaching strategy that could adapt to the general conditions experienced by all professors.

What is Mastery Learning?

Mastery Learning is collective teaching with added frequent feedback and tools for individualized assistance that make it possible for the greatest possible number of students to reach the highest level of success. It rests primarily on the following sequential educational measures:

1) Identification of the prerequisites necessary for the learning we are proposing to the student (acquired knowledge; emotional development).
2) Evaluation of acquired cognitive knowledge and emotional status of the students in relation to the prerequisites. This verification can only be done by means of a diagnostic evaluation and only if the professors themselves have identified the prerequisites.
3) Review of the concepts necessary to acquire the new learning, with students who require it.
4) Formative evaluation followed by corrective teaching, if need be.
5) New teaching… New concepts.
6) Formative evaluation followed by frequent and meaningful feedback. Achievement of the criteria for mastery or failure.
7) Corrective teaching if need be, followed by feedback and enrichment activities for those who have achieved mastery.
8) Summative evaluation.
9) Teaching of a new learning block respecting the same sequence as above.

There is nothing very complicated about respecting this logical teaching sequence. But, underlying the actual teaching measures is the firm belief that all students can succeed at learning. The various conditions mentioned above, including the teaching practices, remain one of the keys to student success.

Lise Dallaire, teaching adviser at Cégep André-Laurendeau, in an article on *Mastery Learning*[4], used the term ‘subversive teaching’. What she meant is that this teaching strategy calls into question even the role of student rating. She was right in that within this approach, rating is used only to confirm that learning has taken place; an evaluation has already been carried out to inform the student of his actual learning.

Positive effects observed in students

Research carried out in the United States, which we have followed closely in recent years, confirms the success of this formula.

In seems evident in light of research carried out by Bloom and his students over a period of fifteen years and reported in an article entitled “The Search for Method of Group Instruction as Effective as One-to-one Tutoring”, that *Mastery Learning,* when applied in all its power and with all its components, is a teaching strategy whose results are very similar to tutorial instruction. A comparison of three groups of students by Bloom – one group receiving tutorial instruction, a second group taught according to *Mastery Learning* and a third group receiving traditional teaching – concluded that 90% of tutored students and 70% of students taught by *Mastery Learning* scored the highest results compared to 20% of students under traditional teaching[5].

Several studies have proven the effectiveness of *Mastery Learning*. Many American elementary and middle schools have globally adopted *Mastery Learning* as their collective teaching strategy. Korea also implemented it on a national level…

At the Second Annual Mastery Learning Conference, an experiment carried out by the City Colleges of Chicago Mastery Learning Project raised many eyebrows. This project implemented new educational techniques in 1972. It involved 450 professors and close to 35,000 students, a good indicator of the interest level for this method, even at collegial level... The experiment was such a success at Olive-Harvey College that administrators are thinking of extending the experiment to all colleges of the CCC[6]. That says it all...

All that was missing here in Québec were the results of our own experiments to guarantee the feasibility of the model at collegial level. This has now been demonstrated thanks to

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[4] DALLAIRE, LISE, Le Mastery Learning, un modèle pédagogique subversif, *Pédagogie Collégiale*, pilot no., AQPC, June 1987.
[5] BLOOM, BENJAMIN S., The Search for Method of Group Instruction as Effective as One-to-One Tutoring, *Educational Leadership*, 1984, vol. 41, no 8, pp. 4-17.
[6] CAPONIGRI, ROCCO, Mastery Learning in the City College of Chicago, *Summary: Second Annual Mastery Learning Conference*, p. 9.

experiments in Shawinigan and at André-Laurendeau and, on a smaller scale, at La Pocatière...

Mastery Learning: a strategy that integrates a range of current teaching practices

It is clear to us that the great strength of *Mastery Learning* is its ability to integrate, in a coherent manner, teaching methods that many professors often practice in the desire to offer quality teaching but, at the same time, use only in a fragmented way. For a number of years, we have been keenly interested in teaching objectives, learning styles, formative evaluations, student motivation and, in a more general way, a choice of diversified and effective learning activities. All these make up the components of *Mastery Learning,* with the following concepts added to reinforce the meaning of the strategy and the choice of learning activities; these concepts are: **prerequisites**, **mastery** and **corrective activities**.

As a general rule, once the objectives of the various teaching blocks are established, we are usually satisfied to teach according to the traditional approach, that is, to address a group of average students and teach in a uniform manner. After an evaluation has taken place, in keeping with learning objectives, teaching is pursued without worrying too much about students who, for one reason or another, achieve weak or mediocre results and find themselves at an insufficient level of mastery to be able to assure their future success.

This point is stressed by believers of *Mastery Learning*. **Make sure that the students being taught have the necessary prerequisites to move on to the next level of learning.** This is the first important principle. Establishing the students' level of mastery of prerequisites needed to learn is an important key. Far from being a waste of time, this procedure saves time over the medium term. After receiving corrective teaching, students progress more quickly through the new learning. Research on Bloom's group is very precise on this point.

A second very important principle is **to specify the criterion of mastery needed to progress from one stage to another, from one learning block to the next**. Here again, the formative evaluation takes on its full meaning and works in tandem with the corrective teaching identified for those in difficulty or who show an insufficient level of mastery.

Corrective teaching is not always implemented despite the fact it would allow a greater number of students to reach the desired levels of mastery. It assumes that the professor believes in the success of all his students and places diversified learning means at their disposal; and, that these planned means are as self-sufficient as possible especially since teachers' workloads keep getting heavier and heavier. It can be done. Teachers at Cégep de Shawinigan achieved it without having to reduce their task load… No one said it was not demanding, but all we need is to believe that it is worthwhile; and this is becoming increasingly self-evident in light of recent experiments.

The third principle consists in **implementing corrective teaching** designed to fill the missing gaps in mastery and also in **planning enrichment activities for the students who have reached mastery,** therefore allowing them to progress further. On that score, the professor's teaching skills must be used to create varied teaching material that is also, as we mentioned above, self-sufficient.

Conclusion

Bloom's research, on the trail of the earlier reflections of Carroll, is sufficiently eloquent to convince us of the need to consider *Mastery Learning* as a most promising educational strategy at collegial level.

This strategy does not mean that professors must reconsider all their teaching practices, since a large number of them already use techniques connected to *Mastery Learning*.

However, *Mastery Learning* requires precise planning on the part of teachers and requires that they create learning strategies that allow all students to achieve the targeted learning objectives.

Mastery Learning has the peculiarity of making the professor work on behalf of all the students and thus appeals to his profound sense of duty and desire to take up the challenge of quality teaching that targets higher levels of performance.

A group of education advisers shows interest for Mastery Learning

While raising questions on the effectiveness of teaching via computer, we became interested in *Mastery Learning* as a general reference. Jacques Gilbert, education adviser at Cégep de Shawinigan, shared our concerns. Mr. René Hivon, of Université de Sherbrooke, then initiated a work group to examine the subject of *Mastery Learning* within the framework of the PERFORMA program.

We wondered at the time, more precisely in September 1984, if the computer was a good way to support professors who wished to adopt *Mastery Learning* as a reference framework and, if the answer was yes, at what level and stage of teaching/learning. Conversely, we wondered whether *Mastery Learning* would be a good reference framework for the professor who wished to teach via computer…

We thus collected a whole series of articles on the subject from various data banks and in particular ERIC. We quickly realized that many articles and research reports on *Mastery Learning* as a teaching strategy had been published in the United States and other countries throughout the world. However, few conclusions were drawn on the effectiveness of using the computer within the framework of this strategy. At most the computer was used within this strategy for purposes such as: management of student files, question bank for different types of evaluation, specific teaching via computer (simulations, educational games). But nothing on its effectiveness. As regards our objective, we were somewhat disappointed at the results of this research…

However, we remained convinced that regardless of what had, or had not been done elsewhere, there were good reasons to include computers in the application of this teaching strategy, as a means of varying the teaching and as a means of providing feedback to the students.

We became even more convinced of the importance of *Mastery Learning* as a teaching strategy after reading some 80 articles which we have indexed.

Teachers show interest

Based on our research, improvement activities were organized in two colleges of the PERFORMA network, at Cégep de Shawinigan and later at Cégep André-Laurendeau. At the same time as these activities, I was using the approach in my teaching of Russian History at Cégep de La Pocatière, in (remote) collaboration with Mr. Jean-Yves Morin at Cégep de Shawinigan.

At Shawinigan as in La Pocatière, the evaluations conducted among students clearly show the high rate of satisfaction and effectiveness of the approach. Jean-Yves Morin was able to convince his colleagues of this effectiveness and persuaded four other teachers to join him in an experiment with a group of students in the field of humanities (without mathematics).

This group of students, known throughout the province for its dropout and failure rate, became the experimental group for five teachers who firmly believed that the approach was going to increase the success rate and decrease the dropout and failure rate.

This experiment, realized without a reduction in task loads, allowed us to confirm the initial hypothesis. Jean-Yves Morin also reported in the local *Bulletin d'informations pédagogiques* of November 1987: "Only one student dropped out of one course in 1987, compared with 25 students who abandoned a total of 34 courses in 1986"[7], a number that had been increasing every year since 1983. In addition to *Mastery Learning*, the professors made sure, during the experiment, they provided their students with learning support tools that allowed them at the same time to acquire a work method[8].

At Cégep André-Laurendeau, another group of professors, in computer science this time, developed a course sequence in this field based on a *Mastery Learning* strategy. In addition to the assumption that a greater number of their students were going to succeed, they also wanted to ensure the development of logical thinking in their students. At the end of the experiment, they were able to confirm that both these assumptions[9] were accurate.

These two teaching experiments took place during the 1987-1988 school years. All the student testimonials concur that they learned at their own rate and felt respected throughout the learning process.

[7] MORIN, JEAN-YVES, « Les aimer concrètement... du concret», *Bulletin d'information pédagogique du cégep de Shawinigan*, vol. 10, nov. 1987, p. 14.
[8] MORIN, JEAN-YVES, *Rapport préliminaire sur une expérience pédagogique basée sur le Mastery Learning portant sur un groupe de sciences humaines sans mathématiques*, Cégep de Shawinigan, 1988.
[9] A report on the experiment was scheduled for publication in the fall of 1988.

Texts 10 and 11

A professional teaching practice
common to every new educational strategy:
The formative evaluation

Two authors have described this professional teaching practice.

1. **Robert Howe**, education adviser in 1991 at cégep Montmorency described this practice in an article entitled *Formules pédagogiques et évaluation formative: une combinaison gagnante* in volume 4, no 4, of *Pédagogie collégiale*, published in May 1991 (p. 8-13).

2. **Ulric Aylwin**, teaching development coordinator at cégep de Maisonneuve in 1995, clarifies this practice in an article entitled *Apologie de l'évaluation formative*, appearing in March 1995 pages 24 to 32 of *Pédagogie collégiale* (volume 8, no 3).

Text 10

Teaching formulas and formative evaluation:

a winning combination

Robert Howe

The concept of formative evaluation is well-known in education. Documentation abounds with simple descriptions of this concept. To place our subject matter in context and in support of the proposed tools that follow, let us restate Scallon's definition[1]:

"*Formative evaluation is an ongoing evaluation process whose goal is to ensure the progress of each individual in a learning process, with the design to modify the learning situation and/or rate of progress and bring about (if necessary) appropriate improvements or corrective measures."*

This definition, like most of the definitions proposed in the documentation, incorporates, explicitly or implicitly, the major concepts of formative evaluation:

- ongoing evaluation throughout the learning;
- individual progression;
- modification of the learning tempo;
- corrective or enriched teaching;
- corrective or improved learning.

In accordance with the definitions, there are excellent texts that offer various tools of formative evaluation.

Gauthier and Saint-Onge[2], and Saint-Onge[3] have developed a grid of formative evaluation tools including a short description and their conditions of effectiveness. These consist mainly of objective or developmental tests as well as the oral interview. Scallon[4] describes several of these tools in greater detail, including a check-list. Other authors, including Bake[5] as well as Barrette and Regnault[6], describe and explore the recent contribution of the

[1] SCALLON, G., *L'évaluation formative des apprentissages. Tome I: La réflexion*, Québec, Les Presses de l'Université Laval, 1988, p. 155.

[2] GAUTHIER, R. et SAINT-ONGE, M., *L'évaluation formative: planification et instrumentation* (modules 5 et 6), Cégep de Sorel-Tracy et Université de Sherbrooke, 1983

[3] SAINT-ONGE, M., *L'évaluation formative*, Programme PERFORMA, Université de Sherbrooke, 1986, p. 486 à 490.

[4] SCALLON, G., *L'évaluation formative des apprentissages. Tome II: L'instrumentation*, Québec, Les Presses de l'Université Laval, 1988, 263 p.

[5] BAKER, F.B., «Computer Technology in Test Construction and Processing», in Lynn, (éd), *Educational Measurement*, 3rd Edition, New-York, Macmillan, 1989, p. 409-428.

personal computer to formative evaluation (computerized testing and adapted testing).

Concerns

Despite abundant and enlightening documentation on the subject and despite the strong presence of the formative evaluation in pedagogical discourse and teachers' own experience in measurement and evaluation, an observer could get the impression that there is little or not enough formative evaluation taking place in class, at collegial level. We have been talking about it for some twenty years but it seems we have difficulty putting our words into action. We hear arguments that would have us believe that a number of teachers find it difficult to include formative evaluation tools in their course planning.

These arguments vary in nature. Mogenier and Parisot[7] studied the reservations of professors in France, with regard to the formative evaluation and several of their common objections originate in the constraints inherent to measurement tools:

- Formative evaluations interrupt the teaching process. We waste valuable time when there is so much subject matter to cover;
- The formative evaluation increases the burden of corrections. Answers to these measurement tools need to be provided. Students expect a grade or at least some constructive feedback;
- Since the beginning of their schooling, students are used to being graded. Thus, they do not attach any value and do not take seriously what is not graded and entered on the report card.

The formative evaluation creates certain difficulties that we have tried to overcome in various ways:

- The mini-test with student correction has precisely the advantage of doing away with correction by the teacher. Moreover, it allows the students to be actively involved in the correction and ensures immediate mutual feedback. But this mini-test is nevertheless generally done in the classroom and "consumes" about fifteen minutes;
- The verification list helps with observation but its use is generally limited to fields that require the ability to follow procedures;
- Computerized testing is a very promising path. Thanks to the PC, the evaluation can be done outside of the classroom, while correction and corrective measures are automated. In this chapter, research carried out by Barrette and Regnault[8] will contribute to

[6] BARRETTE, C., et REGNAULT, J.-P., « Aspects théoriques du développement d'un système informatisé d'auto-évaluation formative à partir d'un modèle cognitiviste», in *La page-écran* (*Bulletin de l'APOP*), vol. 3, nº 2, January-February 1991, p. 5-11

[7] MOGENIER, J.-P. et PARISOT, J.-C., «Formation des enseignants à l'évaluation formative: analyse des résistances et orientations pour cette formation» in *Évaluation formative et formation des enseignants* (texte inédit), Namur, Facultés Notre-Dame de la Paix, June 1983, p. 71-79

[8] BARRETTE, C., et REGNAULT, J.-P., *Op. cit*.

flagging design, production and system management problems so as to show how this type of evaluation can be integrated into the overall planning of teaching activities.

To fully understand the difficulties of using formative evaluations in the classroom and find ways around them, it is necessary to take a closer look at the characteristics of the measurement tools as well as the concept we have of formative evaluation. Cardinet[9] puts us on the right track by reminding us that the school evaluation can have three functions: a predictive function (or diagnostic), an attesting function (or summative) and a formative function. Then he adds:

"The *nature of the required information varies according to the type of evaluation considered, and the tools appropriated for the collection of each type of information will also have different characteristics."* (p. 248)

In the same text, Cardinet draws our attention to research that recommends "we make sure there is a close correspondence between the learning methods and the evaluation methods." (p. 98)

In the following lines, we will elaborate on the interrelations between the decisions to be taken and the tools required to achieve a pedagogical rather than a docimological approach to the formative evaluation.

It is all a matter of perspective (a three-step dance)

If the students have gotten used to being graded, we have perhaps gotten into the habit of associating various measurement tools that result in grades and quantitative data to the evaluation concept. We believe this is the origin of our problems in formative evaluation. The words "measurement and evaluation" generally evoke a certain formality, tools and numbers. However, to facilitate the practice of the formative evaluation in class, we must understand that the information required need not necessarily be translated into numerical symbols.

To put things into proper perspective, let us recall that there are three steps in measurement and evaluation, which are illustrated here by examples in formative evaluation.

First step: the measurement which consists in collecting information and making it meaningful, usually by means of symbols (numbers, letters, etc.). For example: in a given answer, are the elements of a concept present or not.

Second step: the evaluation, the value judgment, based on a comparison between the data collected and the criteria. For example: awareness that a concept "was not understood" in the classroom.

[9] CARDINET, J., *Évaluation scolaire et pratique*, Bruxelles, De Boeck Université, 1986, 269 p.

Third step: the decision, the intervention. For example: a list of corrective exercises, the review of an analogy and adaptation of didactic material.

It is not the measurement tools (1st step) that define a so-called formative evaluation, but rather the nature of the decisions which will be taken (3rd step). *Formative evaluation takes place when decisions are made on corrective measures to be implemented and on implementing these correctives during the learning.*

In the end, the determining factor of formative evaluation, is to be in a position to judge (2nd step) whether the desired learning is acquired and, if need be, to be prepared to correct (3rd step) the teaching or the learning or both, based on valid information (1st step).

When we focus our attention on this third step of the process, we are led to examine our concept of teaching more closely. Hadji[10] stresses the thinking of Philippe Meirieu by stating: the teacher is (also) a decision maker who carries out choices in order to efficiently control the activity of the student. The evaluation can therefore be at the service of learning whether directly, by shedding light on the activity of the learner, or indirectly, by bringing to light the choices of the person whose mission is to facilitate learning.

Therein rests the legitimacy of formative evaluation. It posits the idea that *evaluation must above all be useful in supporting learning*. In a relationship where the professor reacts to the learning of the students, formative evaluation is directly integrated into the didactic material. It is one of the components which led Hadji to propose the concept of *learning assisted by evaluation*.

This vision of learning assisted by evaluation brings docimology closer to pedagogy, opens new venues and allows us to visualize new possibilities as concerns the 1st step of the process.

Teaching formulas

If evaluation means collecting information to make teaching decisions, this information may be expressed in forms other than quantitative. In the classroom, the teacher can very well conduct his teaching based on qualitative information.

Several teaching formulas[11] allow for the observation, directly or indirectly, of how student learning unfolds.

In all these teaching formulas, the students are active and can thus assess in an observable way the quality of their learning. Consequently, professors can witness their students'

[10] HADJI, C., «L'apprentissage assisté par l'évaluation: mythe ou réalité», dans *Cahiers pédagogiques*, nº 281, février 1990, p. 20-23.
[11] For reasons of simplicity and due to a lack of unanimity among authors, we will include under the same expression various teaching techniques, formulas and strategies.

learning.

These teaching formulas are designed primarily for teaching or learning. At the same time, they provide the opportunity to gather sufficiently meaningful information to enable the teacher to make an enlightened decision. Formative evaluation is done during learning, without interrupting it, when the students are involved in active processes like laboratories, teamwork, seminars or when they answer questions in class. Formative evaluation can also be done after the courses, when the teacher reads or listens to extracts of the logbooks or training journals or examines certain networks of concepts.

These teaching formulas fulfill the three requirements stated by Hadji[12] that relate to the concept of learning assisted by evaluation. Because it involves students who are active individually or in a group, these teaching formulas:

- trigger observable behaviour (execution of a task) which is a learning opportunity and , at the same time, an evaluation opportunity;
- allow for the collection of meaningful information, likely to guide the decision-making process;
- allow for the progression from evaluation to action, in the form of feedback, corrective teaching or enriched learning,

Without adding to the burden of correction, all these teaching formulas allow the teacher to gather meaningful information that does not require quantification, but which corresponds nevertheless to the first step of formative evaluation. Within this framework, formative evaluation can profit from the didactic ingenuity of the professor: he can plan his teaching around formulas that are more enriched on the pedagogical level because they serve both learning and the evaluation of said learning simultaneously[13].

Examples

The teaching formulas listed in the table are generally well-known. The majority are currently in use and already serve in formative-evaluation assisted programs. In the form of descriptive charts, we thought it useful to present four examples in order to illustrate how formative evaluation and teaching formulas superimpose each other and how one can use them spontaneously in the spirit of evaluation-assisted learning. These charts are clearly very summative[14] and it would be

[12] HADJI, C., *Op. cit.*

[13] In this spirit, we recommend in particular the following manual:
CROSS, P. and ANGELO, T. A., *Classroom Assessment Techniques: A Handbook for Faculty*, University of Michigan, NCRIPTAL, 1988, 168 p. This handbook offers many pertinent suggestions in the search for formative evaluation strategies.

[14] The number of references has been deliberately limited, but they have been selected precisely because they allow the reader to deepen his knowledge of the pedagogical formula in question.

advantageous to complete them eventually. It is obvious they do not encompass the whole range of possible applications.

Validation

Some might question the validity of an evaluation based on the observation of what the students do or say during the learning process rather than on measurement tools.

If we can assure that the judgement is impartial, then we must stop seeking the absolute objectivity of written tests and numeric grades. When evaluating training courses, for example, we recognize that the observation of the teacher or training course supervisor is subjective. But this subjectivity remains legitimate because it is founded on the recognized expertise of the observer. The measurement is subjective, but based on a recognized expert judgment[15].

In addition, we admit that the nature of the decisions to be taken conditions the docimological type and qualities of the tool to be used during the measurement. The more delicate the consequences, the more we must be meticulous in validating the measurement tools. In formative evaluation, the decisions to be taken, important as they are, allow for the gathering of information in a more spontaneous and informal manner.

We will use mainly pedagogical arguments versus docimological data to justify the legitimacy of carrying out formative evaluation in conjunction with the proposed teaching formulas. Hadj[16] quotes several authors who seem to have become aware of this and who seek to “replace this impossible quest for absolute objectivity with a more coherent relationship between the intention (to assist learning) and the evaluation procedures.

The Journal Book[17]

Situation scenario

Each week, the students are invited to:

- describe the links which they perceive between a new concept and a previously studied concept;
- make a personal synthesis of the concepts introduced in the classroom.

[15] HOGE, R.D. et COLADARCI, T., “Teacher-based Judgements of Academic Achievement: A Review of Literature”, in *Review of Educational Research*, Fall 1989, vol 59, nº 3, p. 297-313.

[16] HADJI, C., *Op. Cit.*

[17] FULWILLER, T., *The Journal Book*, Upper Montclair, N.-J., Boynton/Cook, 1987, 402 p.
MÉNARD, L., *Utilisation de l'écriture au collégial: étude descriptive*, Rapport de recherche PAREA, Laval, Collège Montmorency, June 1990, 120 p.

Pedagogical benefits

The journal book stimulates a personal and active involvement in class. It makes it possible to establish abstract links between knowledge and experience. It favours the integration of knowledge.

Formative evaluation

Information gathering: The professor does a weekly reading of articles from various newspapers.

Possible decision: During the next course, there can be a review of errors detected, oral clarification of concepts in class or discussion on identified links.

Teamwork[18]

Situation scenario

After a summary presentation, the students are divided into teams of four to carry out a specific task in the classroom.

Teaching benefits

The students are active and learn how to solve problems in groups.
Teamwork supports tutoring by peers and mutual assistance.

Formative evaluation

Information gathering: During the work, the professor circulates between the groups taking notes on the nature and quality of what is being done in relation to the task to be completed.

Possible decision: During the next course, there can be a review of errors detected, oral clarification of concepts in class or discussion on the links identified.

Networks of concepts[19]

Situation scenario

After a presentation on a subject, the teacher asks that dyads create networks of concepts based on the concepts presented.

Teaching benefits

The creation of a network becomes a learning mode. Teamwork engages the students actively. Shown on a single sheet of paper, the networks illustrate the understanding students have of the contents.

Formative evaluation

Information gathering: The professor circulates among the teams or randomly asks two or three teams to orally explain their network.

Possible decision: The professor immediately sees what was not understood and where his teaching was not clear. He can thus immediately review both the content and his teaching.

[18] SLAVIN, R. E., Synthesis of Research on Cooperative Learning, in *Educational Leadership*, vol. 48, nº 5, February 1991, p. 71-82.
[19] NOVAK, J. D. and GOWIN, D. B., *Learning how to Learn*, New-York, Cambridge University Press, 1989, 199 p.

Asking questions in class[20]

Situation scenario

During the course, the professor asks questions of varying levels of complexity and leads the students to find answers.

Teaching benefits

Questioning is used to guide the review, to recap.
Students learn how to formulate and use various levels of questioning to study and to learn. These questions are exercises in critical thinking.

Formative evaluation

Information gathering: Attentive listening to the contents of answers provided, the number of students who answer as well as the nonverbal behaviour helps the teacher identify the quality of the learning.

Possible decision: The teacher can intervene to comment on and correct the answers (restatement of the presentation, corrective teaching and enrichment). He also takes the opportunity to adjust and fine-tune his questions.

Conclusion

It is not our intention to suggest that we should eliminate the use of measurement tools in formative evaluation. They will always be relevant and we will be able to benefit from them even more once we reduce the drawbacks and increase the effectiveness of computerized testing, for example.

We also concur with the fact that using teaching formulas, within the framework formative evaluation, has several advantages:

- all these formulas are directly useful for learning;
- the students are actively involved;
- consequently, all these formulas can provide information to the professor on how learning is progressing;
- they do not require any writing or correction of exams;
- they do not require any interruption of the teaching or learning process.

Altogether, the main thrust of these teaching formulas is perhaps to confirm to teachers that they already successfully implement formative evaluation and to encourage others to give it

[20] DILLON, J. T., *Questioning and Teaching: A Manual of Practice*, New-York, Teachers College Press, 1988, 195 p.

a try. In all situations, formative evaluation via a given teaching formula, in the classroom, should be compatible with the teaching and evaluation concepts described by Mogenier et Parisot[21]:

> "While insisting on the fact that an evaluation is the gathering of information to facilitate learning, the teacher is invited to join in a Copernican revolution. It is no longer teaching that is important, but rather the optimization of the teaching apparatus to the benefit of student learning."

[21] MOGENIER, J.-P.et PARISOT, J.-C., *Op. cit*, p. 74.

Text 11
In defence of formative evaluation[78]

Ulric Aylwin

This text recommends and intends to demonstrate the need to eliminate the summative evaluation used during a trimester and to reserve it exclusively for the very end to evaluate the "sum total" of learning. It is our opinion that evaluations conducted during the course itself should only be of the formative type."

It is self-evident that such a position is likely to shock many, including those who are deeply involved in their current teaching practices, those for whom the summative evaluation is also an opportunity to give formative feedback, those who wear themselves out correcting students' work or examinations, and those who feel they need the pressure of grades to incite students to carry out or improve their execution of certain learning tasks.

These are the people that we want to forewarn by stating that if the concepts discussed here systematically oppose formative and summative evaluations, their purpose and respective roles, it is certainly not to discredit the work achieved by those who have amalgamated these two evaluations.

In short, this text proposes a new practice in which a conscientious professor will be able to devote his energies to the creation of tools and teaching strategies rather than the correction of papers, and where the level of student motivation will be that much greater knowing that it will no longer depend on grades.

For the very large majority of teachers, to evaluate means to correct and to grade, in other words: to do a summative evaluation.

However, without denying the essential nature of the summative evaluation, we want to draw attention to the fact that it has harmful effects when it is introduced within the course itself, instead of restricting it to a more limited role of evaluating the sum of knowledge acquired by the student at the end of the learning period. What we would like to see happen first and foremost is for the word 'evaluation' to spontaneously evoke the image of motivated students within a formative evaluation approach rather than of a professor making a summative evaluation.
The main thrust of our text will thus be "the defence and illustration"[79] of formative evaluation, on a background of caution against the encroachment of summative evaluations.

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[78] This text restates and completes the ideas expressed in the two conferences given by the author, one at Cégep de Trois-Rivières, on November 9, 1994, entitled: "Évaluation formative et formation", the other at Cégep de Saint-Jean-sur-Richelieu, December 6, 1994, entitled: "Dis-moi comment tu évalues, je te dirai comment tu enseignes".
[79] J. du Bellay will forgive us for referring to the title of his *Apologie de la langue française*.

To accomplish this, we must start, as suggested by Paul Valéry, by "cleaning up the verbal environment."

Delineation of concepts

Formative evaluation, as its name indicates, takes place during learning and is designed to regularly inform the student and the professor on the degree of success of the learning and the teaching. This evaluation does not provide any grade to be entered on the student's report card. Conversely, the summative evaluation, as its name indicates, aims at evaluating the sum of knowledge or skills acquired at the end of a stage or an entire course. This evaluation results in a grade entered on the student's report card.

Formative evaluation and summative evaluation

To better understand these two types of evaluation, we will describe in a comparative mode their respective characteristics.

The first characteristic sheds light on radically different goals, and consequently, on the relative importance of the two kinds of evaluation. It is clear that the goal of the formative evaluation is to help the student develop for himself, while that of the summative evaluation is to help the administration decide the academic fate of the student. However, unless we believe that children are born and attend school primarily to be evaluated by administrators, it goes without saying that formative evaluation must come first in education, the other form of evaluation being a constraint imposed at school for administrative purposes.

The second distinction (competence and performance) is complementary. On one hand, there should be no limit to the amount of growth a student wants to experience – something we should strongly motivate – in a course. Such growth is sustained by the use of formative evaluation. On the other hand, the level of requirements, on a summative plane, cannot exceed the degree of performance that we can "reasonably" expect of a student in a given course. In other words, there are no limitations as regards targeted competency, whereas there are precise thresholds established to measure required performance (we will come back to these concepts later).

The third feature (aspects covered) clarifies the preceding distinctions. In all courses, regardless of subject matter and academic level, what matters first and foremost is the basic education and also the acquisition of a general culture. These aspects lend themselves readily to formative feedback, but are difficult, on the summative plane, to evaluate accurately within the framework of a particular course, considering we are dealing here with education that transcends the actual courses, disciplines and levels of the school environment. This is why we stress the fact that, while a formative evaluation can cover all possible aspects, we must limit our expectations as regards a summative evaluation.

Another source of divergence between the two evaluations is their respective goals which lead them to view the same object in a different way. Thus, relative to the acquired knowledge of the student, a formative evaluation seeks to make a diagnosis on the nature and origin of the missing elements, whereas a summative evaluation is limited in scope to identifying the elements that determine the grade to be accorded.

To take the above logic one step further, a diagnosis made within a formative framework leads naturally to an action plan on the part of the professor and to corrective teaching for the student, whereas, within the framework of a summative evaluation, the grade will be used to classify the student on the academic plane and, possibly, allow or prohibit access to the next stage.

The sixth major difference refers to the work achieved by the student and the professor in each type of evaluation. Since the principal agent of learning is the student, and since evaluation is at the heart of all learning, it goes without saying that it is the student who must accomplish most of the work in a formative evaluation approach. On the other hand, since the professor is the agent who represents society, and since the grades he assigns have a decisive impact on a student's future, it goes without saying that it is the professor who does the work required in a summative evaluation[80].

The final characteristic (to which we will return later) is that the very nature of each type of evaluation requires that formative evaluation be done frequently, while summative evaluation be limited to occasional use during the trimester or, even better, be used only once at the end of the course.

[80] Normally, summative evaluation is done entirely by the professor. In certain situations, in internships for instance, or in certain teaching formulas, it is possible for other parties, including students, to contribute to the grading.

FORMATIVE EVALUATION	SUMMATIVE EVALUATION
1. Its goal is to educate the student.	1. Its goal is to provide information to the administration.
2. Aims at maximizing the acquisition of competency.	2. Seeks primarily to identify a minimum threshold of performance.
3. Covers as many aspects as possible.	3. Covers the essential aspects.
4. Diagnoses the nature and the origin of gaps in knowledge.	4. Measures the extent of gaps in knowledge.
5. Leads to an action plan and corrective measures.	5. Leads to classification and selection.
6. Entrusts the student with the greatest portion of the work.	6. Entrusts, in general, the totality of the work to the professor.
7. Is very frequent.	7. Is rare.

Competency, tasks and performance

Before making a more detailed study of the two kinds of evaluation, we must distinguish between three other concepts: competency, tasks and performance.

Competency is the overall knowledge, skills and attitudes that are acquired gradually, and which form such a complex whole that we can only get fleeting glimpses of, based in the execution of a task where it manifests itself, even a task as simple in appearance as formulating a sentence. It would therefore seem rather pretentious to believe for instance that, based on a drafted analysis of a style of writing; we can deduce the extremely complex competency that underlies this ability[81]. Actually, given that competency is invisible, it will always be beyond any measurement tool. The only thing we can observe, and thus measure, is such or such a manifestation, that "implies" such or such underlying competency. In other words, all we can observe are performances, whose link to a specific competency will always remain uncertain.

These distinctions will be useful for us when we return to the summative evaluation. But first let us examine the formative evaluation.

Formative evaluation

[81] In spite of the obvious gap between competency and task, certain civil servants at the ministère de l'Éducation du Québec, showed a lack of reflection when they recently affirmed that they defined programs "by competency", when in fact, they limited themselves to identifying the tasks to be achieved at the end of the trimester. This is like saying that singing "row row row your boat" constitutes a competency or enables you to evaluate the vocal and musical talent of the singer.

The importance of formative evaluation will become more obvious as we examine why it is of primary importance and why it must be frequently used. This will be followed by a look at how the professor and students are to intervene in such a context.

Advantages of formative evaluation

The value of this evaluation lies in the fact that every learning action only reaches completion when there is feedback that informs the learner of the relevance and effectiveness of his action.

Let us examine a few reasons to choose formative evaluation, by referring to Edward Deming, creator of the *Total Quality Management (TQM)*) model. Among the fourteen principles on which Deming bases TQM, there are three, according to us, which refer to formative evaluation.

- The first principle is that we should emphasize the process rather than the product. The product is just that, a product, i.e. the result of a process. If the product is defective, it is because there were gaps in the process. Therefore, quality control must be exercised at every stage of the process. In learning, this implies that the student is called upon to control every stage of his work, with the professor's help, and to progressively correct the gaps in learning that are identified. For example, it is not only necessary to identify the gaps in an introductory paragraph, but also to ensure that the paragraph be adequately rewritten immediately, instead of relying on a hypothetical improvement in a future production.

- The second principle is that cooperation is more effective than competition. In the "quality circles", inspired by the philosophy of Deming and which contributed immensely to the success of Japanese industry, foremen and workmen are part of a team where all the decisions are made jointly. The team has only one goal: to improve. The only competition of the team is itself. In education, this means that the classroom is a community of learners where the professor and the students make up a large circle of quality that includes more restricted circles that are made up by teams created for cooperative learning. It is only in such a context that the resources of individual students, the professor and the entire group can be put to full use.

- The third principle is that a climate of security is more productive than a stressful one caused by external control and "performance bonuses". Experience has shown that employees who work under pressure to meet quotas set by company executives, and who risk being penalized for insufficient production, have a lower output than employees who work in a climate of confidence and security. In a stressful environment, people do not give their "all" and lack creativity. In the context of learning, this implies it is necessary to avoid placing students on a sort of assembly line, where they must all produce the same result, in same quantity and at the same rate. This supposes, in particular, that we give up the use of grades as a motivational tool, and put the emphasis, instead, on formative feedback.

Other reasons, based on current teaching experience, also support formative evaluation.

- When an evaluation is done by the professor, it is done quickly. When there are grades connected to the work, what is costly time-wise are the precautions that must be taken to ensure an adequate response to eventual "grade negotiators". Conversely, in the relaxed framework of simple formative feedback, we quickly identify the qualities and gaps to be brought up with the student.

- With formative evaluation, as seen earlier, it is possible to take basic education into account which is more difficult to assess in a summative evaluation administered for report card purposes. It is very difficult to isolate the specific effect that teaching dispensed over a limited number of hours has on competencies that require a lifetime to master. More precisely, any evaluation, in any discipline at the collegial level brings into play the teaching received by a dozen previous teachers. From this perspective, a formative feedback is not problematic, while "grading" the content of basic education, as if this education was the result of our teaching, is hazardous. This is equally true when talking culture. Culture is based on childhood foundations and develops through time; it is greater than any one individual course. To reiterate, formative feedback is necessary and easy to do. A summative grade can be a dangerous tool.

- The formative evaluation makes it possible to reduce the burden of corrections, by entrusting to the students the essence of the work involved. Here is how it works: students must frequently produce a variety of work that is an essential part of their learning process; this work must obviously be evaluated and corrected. Since the professor does not have the time to do the work himself, it must be handled by the students. This is not possible within a summative framework, because the professor himself must guarantee a valid, complete and reliable evaluation. Consequently, all the tasks that do not absolutely require grading, should be evaluated within the formative framework and should be entrusted to the students.

- When the formative evaluation is completed mainly by the student, he then assumes, and rightly so, the responsibility for his education. It is essential that that the student be at the centre of all cognitive activity, since he is the only person who can educate himself. Concretely, any analysis, evaluation or correction done by the professor "rather than" by the student deprives the latter of a learning opportunity[82]. Seen in

[82] One of the principal reasons for the incompetence of students in French, right up to university level, is due to the fact that the majority of teachers, from the primary level

another perspective, the fact of allowing students to assume responsibility for their work, results in a healthy professor-student relationship, where the professor does not try to be the orchestra player who knows all the instruments better than the musicians, but rather the orchestra leader who helps each musician give his very best.

- Another advantage of the formative evaluation, which has already been alluded to, is its diagnostic and descriptive nature. The purpose of an evaluation is to provide accurate information on various aspects of the student's work. Whereas a global grade offers no information on what it covers, comments made within a formative framework focus on qualities and weaknesses in work as well as improvements to be made[83].

- The final advantage we will discuss here (the list could go on) rests on the fact that formative evaluation enables and even elicits intellectual risk-taking, contrary to a summative framework which invites students to stay on beaten paths. In the latter situation, coming up with an original solution, expressing a personal thought or using a different style is likely to generate bad grades. So it goes without saying that the student will prefer to stick to the old recipes. In a formative context, on the contrary, divergent thinking, the courage to live new experiences, a taste for risk and originality are values that not only come into play but can be recognized and encouraged.

The need for frequent formative evaluations

All learning activities require feedback that informs the learner on the relevance and the effectiveness of his physical or mental actions.

For example, on a physical level, no one would expect a ski instructor to defer the evaluation of a posture or movement likely to cause a serious fall to a later summative date. Similarly, on the intellectual scale, consider the case of didactic material in computer software that allows a user to be immediately informed of the correctness of his reasoning, the relevance of his decisions and the effectiveness of his actions at each stage of the process.

The need for frequent feedback is obvious; we can better understand its scope by successively examining its impact on cognitive and emotional levels.

- The first argument in favour of a formative evaluation and its frequency is **of a cognitive nature**: we want to ensure that *learning is adequate and has been properly mastered.*

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up, handle the evaluation of the work of their students themselves, preventing the latter from acquiring a mastery of the language.

83 It should be recalled here that in current practice many professors justify grading by adding more or less detailed comments, thus incorporating formative feedback into the summative evaluation; but these comments come at a disproportionate cost in terms of burden of corrections.

- *Adequate learning* means that the concepts taught are understood by the student from the very start, in a correct and precise way: correct, i.e. the student correctly grasps the meaning of the words or the formulas used; precise, i.e. the characteristic features of the concept are perceived with clarity and the semantic borders of a given concept are clearly distinguishable from similar concepts.

  What is necessary to stress as concerns formative evaluation, is that the initial contact with the concept under study must be adequate. This is because the processing of all data occurs via a neuronal circuit whose path becomes imprinted and engrammed in the brain due to a physicochemical reaction occurring at each synapse. Consequently, whenever the student is faced with the same stimulus-information, he will process it according to the neuronal pathway. Therefore, if a student does not "grasp" a concept from the start, any recall will only serve to reinforce the error.

  Fortunately, a concept is not usually stored instantaneously in long-term memory. It remains, for a certain period of time (from a few seconds to several minutes) in short-term memory, or working memory, where it is still possible "to work" on the concept and correct the flaws… on condition, of course, that a formative evaluation intervenes early enough to allow the student to detect his error and enable him to correct his neuronal circuit in time.

- Properly mastered learning involves at least two things: the deepening of comprehension and long-term memorization.

  The deepening of comprehension requires that the student review for himself and in his own terms, the information received. This also implies that the student stores this information in his brain within other related and relevant information networks already stored there. For example, the concept of homeostasis in biology will be put in a parallel relationship with the thermostat concept in physics, or the balance between supply and demand in economics. It is precisely this process that is made possible by every formative evaluation, which forces each student to reactivate information, to verify the interpretation of it and to store this information in a relevant place within a suitable network of concepts.

  In connection with storage in long-term memory (as noted earlier, this is not a spontaneous act), in many cases, it simply does not occur. What does occur is that what the professor says goes in one ear and right out the other, without no data stored at strategic points in long-term memory where it could be recalled if the student needed it. Contrary to this, every exercise in a formative evaluation gives the student time to re-think information and interpret it according to subjective cognitive models. This is what allows the information to be firmly stored in long-term memory.

- The second reason for doing frequent formative evaluations is **of an emotional nature** and touches upon several aspects of motivation.

  In the case of a presentation for example, motivation is generated by including evaluations that allow the student to stop and check his comprehension of what the professor is presenting. In this way, a situation is created in which those who have not understood can identify and fill in the gaps, while those who have understood get to see their learning reinforced. This process of periodic reviews, of "self-portraits"[84] is one of the best ways to motivate students. A student in difficulty will want to improve the negative self-image being reflected back to him; and, the student who succeeds will want to maintain his favourable image.

  Another advantage of the formative evaluation is the feeling of security that comes with awareness of personal progress and recognition of gaps in learning. A student who sees his success is reassured. In the same way, a student who sees the gaps in his learning is reassured because he knows exactly what he must acquire.

  A final source of motivation is the challenge with which each formative evaluation confronts the student. It is this challenge that piques the student's curiosity, energizes his will and creativity and his desire to succeed.

In summary, frequent formative evaluations are invaluable for their effectiveness at cognitive and motivational levels.

The use of formative evaluations in a course

Let us first distinguish between the evaluation done at the start or end of a course, and the evaluation occurring regularly throughout the course.

- In the first instance, the purpose is to verify, by a test or an exercise, either before or at the start of the course, what knowledge each student already has in relation to the subject matter that will be presented. Then, another test or exercise is administered at the end of the course to give each student the possibility to see what knowledge or new skills he has acquired in the course.

The preliminary formative evaluation is doubly necessary; on one hand, before broaching a new subject matter it is essential that the student reactivate prior knowledge, initially to avoid wasting his time with what he knows already, then to allow him to

[84] By "self-portraits" we mean that each student, through the use of formative evaluations, is obliged to take a series of snapshots of the state of his knowledge; these photographs reflect back to the student a precise image of his cognitive performance.

confront and integrate the old and the new learning and, finally, to have him formulate questions on the new subject matter to be covered. On the other hand, becoming aware of where he is at the start of the course and also at the end shows the student his progress during the course, an essential condition for maintaining motivation. So the role of the evaluation done at the end of the course is to highlight the progress made, while ensuring a synthesis of the course.

These two instances of formative evaluation are brief and do not demand any correction on the part of the professor. It is up to each student to verify his own level of knowledge versus the answer sheet provided by the professor.

- As for the series of short formative evaluations that should take place during the course, we suggest the following formula. Approximately every fifteen minutes, the professor suspends his presentation and asks a question, or asks students to perform an exercise that will allow each student to evaluate his comprehension of the subject matter that has just been introduced. Concretely, students working in pairs take a few minutes to find the answer, after which the professor checks the answer given by a few of the dyads then reveals the expected answer. Only then does the presentation continue.

It is very important to note here that the form and frequency of the formative evaluation can vary significantly depending on the methods used. We have referred here to a lecture framework. In the case of teamwork or laboratory experiments, for example, the teaching method or activity itself contains various modalities of formative evaluation, which eliminates the need for frequent interruptions for evaluation. We are assuming here, in a lecture framework, that the presentation is filled with new terminology and concepts, hence the need for frequent applications of formative evaluation. When the presentation mainly involves the comprehension of a general perspective, the observation of a demonstration or the awakening of personal insight, it is not necessary to resort to such frequent formative evaluations.

Within a presentation context, we propose that each formative evaluation be short, that it not involve any correction for the professor and that it make it possible for each student to correct, if need be, his comprehension of the concepts, before they become fixed in long-term memory. The formats which these questions or exercises can take are varied. Here are some examples:

- identify key words that capture the essence of the previous presentation;
- give an example of a rule or concept that has been introduced;
- identify the rule or concept introduced by giving an example;
- identify concepts in the presentation that were not understood;
- link elements taken from both lists;
- compare notes;
- write a sentence-abstract or a recap;
- draft a question covering the essence of the subject matter that has been introduced;
- draft questions and answers;
- identify tenets or outcome of a result or situation;
- place facts and data in chronological order or classify by order of importance;
- build a schematic of the concepts;
- find the missing, erroneous or foreign element in a given definition or diagram.

All these exercises further the goal to provide students with feedback on the quality of their learning at sufficiently frequent intervals. This formula has many other advantages as well:

- better learning, thanks to feedback on performance, correction and reinforcement of concepts;
- motivation as a result of ongoing supervision provided by the professor;
- motivation through a series of self-portraits;
- memorization through the reactivation of knowledge;
- memorization through the varied treatment of the concepts by the student;
- renewed attention by varying how the exercise unfolds;
- information for the professor on the learning achieved.

As we can see, the formative evaluation can be frequent without encroaching on the time spent teaching and without increasing the burden of corrections. Thanks to this frequency, it can also help achieve the benefits listed above.

Students assume responsibility for the evaluation

What has been discussed above is the active participation of students involved in their learning thanks to a simple series of questions from the professor. Can the student be expected to assume responsibility for the evaluation of complex work?

Why?

The first reason is that the quality of a student's learning depends directly on his ability to adequately evaluate his learning. This point is crucial: there is no real learning as long as the "quality control" of the learning remains apart from the learner. The learner must always be the first to evaluate his ideas and productions. He must, gradually, with the assistance of his fellow students and the professor, acquire complete mastery of the criteria and the tools necessary to adequately appreciate the relevance, quality and effectiveness of his actions.

It is not a question of diminishing the role of the professor in evaluations but rather of positioning it. The role is primarily to teach students self-evaluation and allow them to assume ever increasing autonomy in assessing what they are doing.

The second reason is the need to develop the capacity for metacognition in the student. Metacognition is the ability to know how we learn, to see how we think and therefore manage our learning process more effectively. For instance, the ability of a student to see how he proceeds to understand exam question, what he does to retrieve relevant information from his memory, etc. Research has shown that metacognition is one of the key traits in students who succeed.

Metacognition is an integral part of self-evaluation; it causes the student to become aware of his learning process; and is an essential element in any teaching strategy.

The third reason is the need to minimize the burden of corrections. The key role of a professor should be the creation of educational strategies and tools to support the strategies so his students can learn. However, time is required for this creation and if the professor spends all free time on summative evaluations, it becomes impossible to create. It is important therefore, that the summative evaluation be reduced to a minimum while we maximize use of formative evaluations entrusted to the students themselves.

How?

In general, students who begin college are poorly equipped and ill prepared to evaluate their own work. It is necessary to identify a strategy to allow for the gradual development of this capacity for self-evaluation.

The first stage of the strategy will be to encourage students to take control of their own evaluations. To show them how to rebuild confidence in their own judgment which may have been lost somewhere along the academic road traveled.

The second stage will help students define the criteria for each activity so they may evaluate their work correctly. This can be done through a series of exercises where students evaluate their own work according to a specific criterion – coherence for example – and then justify their evaluation with supporting proof. One way to do is to have students evaluate the same text. In groups of four, each team evaluates and assigns a fictitious grade to the work presented, based on the selected criterion. Together, teams then work towards a consensus on the final grade. The criterion is clearly defined through the use of examples, with the help of the professor in a plenary. Another simple formula is to have each of the four students supply their own text. In this case, the individual initially evaluates and grades his own work, then allows each of the other three to evaluate also, one after the other. The student then does a final evaluation of his work, based on the evaluations he received from the other three. The last step is a plenary session with the professor to ensure students have a clear understanding of the criterion. This approach is repeated for all other criteria.

The third stage requires that all work handed in to the professor be accompanied by self-evaluation, wherein the student will have assigned a (hypothetical) grade to his work and justified it.

We can see that the process implies that students initially evaluate their own work; then the work of others; at the end of the process, the professor intervenes with a progress report. The degree of seriousness to which students undertake this work depends on the follow-up done by the professor. It is also dependent on the degree to which the students recognize that they are building for their future and acting on their ignorance and incompetence.

There are many ways of using formative evaluations without overloading the professor. For example, the students can be asked to draft a summary at the end of each course that will allow them to clearly see what they have learned. Previous course contents can also be reviewed at the start of the next class.

In addition to evaluating their work, students can also contribute to the preparation of examinations. They may recommend questions on specific topics or draft questions themselves and the correct responses, etc. Since learning belongs to the student, the professor should entrust him with the greatest possible number of pedagogical tasks likely to support his learning.

After this tour of the formative process, we can better understand the summative viewpoint.

The summative evaluation

Many people lack a clear idea of the exact role played by the summative evaluation. This misconception is apparent in the manner in which the summative evaluation is used and overused, and the subsequent teaching difficulties. The solution consists in limiting the summative evaluation to its specific role.

Confusion surrounding the summative evaluation

In general, professors maintain a love-hate relationship with the summative evaluation. On the one hand, they like it as a "motivational tool", i.e. they use the threat of grades to motivate students "to work"; on the other hand, they bitterly deplore that students "work only for the grade". Primarily though, professors rightly complain about the burden of corrections which these evaluations necessitate.

There is another reason for the frequency with which a professor will use summative evaluations during the trimester. It is the belief that evaluations should be administered and graded by the professor. Since students must be regularly provided with updates and evaluations on their performance, this leads to the erroneous belief that there must be a specific number of "summative-formative evaluations". As a result, both forms of evaluation become corrupted.

Problems arising from the use of summative evaluations during the trimester

The first difficulty is that evaluations done during the learning phase cannot really be called "summative" since it is only at the end of the session that we can measure if learning has been sufficiently integrated to allow the student to achieve the complex tasks identified in the objectives.

In fact, a grade resulting from averaging the score on several summative evaluations given during the trimester can be misleading as it provides a false assessment of the actual performance level of the student, at end of course. For instance, let us compare the average results of two students in a course where the last of four summative tests is a final recap exam that covers all the subject matter. Student A, who did remedial work, scored the following percentages: 30, 40, 60, and 90, for an average of 55%. Student B made sure that he applied himself early on in the trimester to get a good final average, then invested less and less time in his studies as the trimester progressed. His percentages were: 80, 75, 70, 65, giving him a general average of 72.5%. As a fact, student A achieved greater mastery of the subject matter than student B - a 25% difference. However, the grade entered on the report card shows him to be 17.5% below his fellow student.

A second more serious problem that impacts learning is the loss of intrinsic motivation. An assigned grade is an extrinsic reward (or punishment) for work done. It originates outside the student and does not have any intrinsic value for him, i.e. this reward/punishment has no connection with work on personal development in which the student is both the initiator and the recipient.

Research clearly shows that extrinsic motivation has minimal impact on galvanizing a student into action and devoting energy to his studies. In fact, the more frequently we assign grades, the more we see a decrease in student interest for the subject matter itself. A vicious circle quickly ensues. The professor who is faced with students who lack motivation leans more and more heavily on the threat of grades to motivate them. Meanwhile students with little or no intrinsic motivation require, and expect, increasingly high grades. In other words, education loses its meaning and the young believe that what counts for them at school is not preparing for their future life and destiny, but rather getting good grades to satisfy the needs of the system[85].

Another problem that comes with extrinsic motivation is that students limit their efforts to doing only what is necessary to get a good grade. This is reflected in such questions as: "Does this count? Will this be a question on the exam?" Under these conditions, the student limits himself to *surface learning*, learning by rote and applying formulas mechanically without questioning the principles or the applications. Conversely, intrinsic motivation seeks to deepen understanding and achieve *deep learning*, by analyzing the structure and the meaning of knowledge, by linking new concepts to personal experience and by discriminating between arguments, evidence, relationships, structures and others[86].

In closing, the use of frequent summative evaluations during the trimester results in intrinsic de-motivation. Learning becomes superficial and fleeting given that after the exam, a student discards the content he has memorized since his goal has been reached: getting a good grade. All of which reinforces the importance of limiting summative evaluations to their role as final evaluation.

The role of the summative evaluation

The summative evaluation belongs at the end of the learning process.

Given our preference for summative evaluations, it can seem unacceptable to postpone this evaluation until the very end and to rely on formative evaluations during the trimester. However, this is the way it is done in nursing for example where training takes place at the hospital. We also find this practice in most disciplines; for example, in skiing, the instructor does not get his diploma based on the accumulation of grades given after each lesson, but rather by demonstrating that he has acquired the learning and required skills by the end of the course.

Other examples are law and medicine where we do not become qualified in a given field because we can demonstrate our scattered knowledge of the subject matter, but because we can solve complex problems by applying a whole range of knowledge and capacities

Moreover, all new courses at collegial level are defined (or will soon be) according to a general objective described in the form of a task to be achieved by end of course, and a synthesis-exam (comprehensive assessment) to be successfully passed as a condition of certification. This amounts to nothing more than a larger than life summative evaluation.

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[85] For a very detailed study on the devastating effect that regular use of grades does to motivation and the quality of learning, we recommend reading the research published by Alfie Kohn, *Punished by Rewards: The Trouble with Gold Stars, Incentive Plans, A'S, Praise, and Other Bribes*, Houghton Mifflin, 1993.

[86] Refer to Guy ROMANO, « Étudier... en surface ou en profondeur?" *Pédagogie collégiale*, vol. 5, n° 2, December 1991, p. 6-11.

The normal standard we want to achieve is one summative examination at the end of each course.

In closing, we briefly look at the interaction which exists between formative and summative evaluations.

Relationship between formative and summative evaluations

Learning that is evaluated at the summative stage will have benefited from feedback given during the learning process; however, this does not mean that both evaluations cover the same material. It is also important that the content of the summative evaluation does not exceed that of the formative one, although the reverse is not true. Learning acquired during the trimester should overflow the borders of the summative evaluation. In other words, there are no limits to the learning we must help students acquire during the course, whereas there are very precise pre-established borders that should not be exceeded with summative evaluations.

What we stated about the content is true also for the forms and the means of evaluation: the summative evaluation must not include types of questions that were not used within the formative framework.

The number of category-based questions will vary between both forms of evaluation. For example, a formative framework may ask many developmental questions that are necessary for learning but do not add to the burden of corrections; whereas in a summative examination, there should be only be one developmental question to gauge mastery but many objective questions that provide measurement yet do not require long written answers, thus avoiding extra corrections for the professor[87].

Another difference between the two evaluations is that the formative one is detail-oriented whereas the summative one is global for ease of correction as well as validity and measurement accuracy[88].

As we can see, there is room for much flexibility in the contents, form and ways of using formative evaluations, whereas a summative evaluation must not exceed the ground covered in the course, nor the scope of the task set as a course objective.

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[87] The objective questions which we refer to are those that can measure complex performances; thus, "true or false" and "please complete these sentences" do not allow us to measure much. “Multiple choices” can be a good tool, but it is very difficult to structure. In our opinion, the richest form of objective evaluation is that provided by incomplete questions that require the student to correct and to complete complex answers that are provided with the questions. Refer to Ulric AYLWIN, *La différence qui fait la différence*, Montréal, Éditions AQPC, 1992, p. 87: «Vaste question corrigée en un clin d'œil».

[88] Refer to Ulric AYLWIN, «L'évaluation globale de la qualité des textes», *Pédagogie collégiale*, vol. 7, n° 4, May 1994, p. 13-15.

Conclusion

The summative evaluation used as a motivational tool and as a periodic information vehicle for students is so ingrained in teaching methods that it is difficult at first glance to imagine a practice that is at the opposite pole i.e., an approach to motivation where the absence of graded evaluations is the first principle. And the situation appears even more Utopian when we realize just how much change is involved in the academic organization and the professor-student relationship.

However, testimonials[89] from professors who have eliminated the summative evaluation in favour of formative ones are unanimous: admittedly, the first steps are difficult and require much work (to restructure the teaching), but positive results are quickly seen and soon the professors are convinced that it is the right path. The results are threefold:

The first effect is a strong increase in student motivation. Liberated from the Pavlovian reaction to grades i.e., released from the obsession of grades for the entire trimester, the only remaining motivation for applying themselves on a daily basis is the students' desire to acquire something useful and important for themselves.

The second result, a consequence of the first, is a clear improvement in the quality of learning. No longer dependent on external gratification, students look for satisfaction in the quality, the beauty we could say, of what they succeed in producing by and for themselves.

The third advantage is mainly for the professor. He stops being seen as a controller and a "pressure tactic salesman" and can now be regarded as the key resource of the group, needed by all to succeed in their personal endeavour.

To incorporate the formative evaluation into the core of the pedagogical fabric is admittedly not enough to guarantee success, but it is a fundamental condition for this success, and perhaps the best bet yet.

89 Refer to, among others, Claude Lamarche and several of his colleagues in *Gérer l'éternel triangle - Élèves, professeurs, école*, Montréal, Beauchemin, 1994, 173 p.>, in particular, chapter 12, p. 151-162.

Texts 12, 13 and 14

Conditions that support the implementation of new educational strategies at collegial level

Two authors describe these conditions.

1. **Ulric Aylwin**, teaching development coordinator at cégep de Maisonneuve until 1997, describes the conditions needed for the development of new educational strategies in two articles of *Pédagogie collégiale*. The first, published in May 1996 (pages 16 to 20) in no 4 volume 9 entitled *Transformera-t-on enfin la pédagogie* ? The second, published in October 1997 (pages 25 to 31) no 1 of volume 11 of the same publication entitled *Les croyances qui empêchent les enseignants de progresser*.

2. **Jacques Tardif,** professor of the Faculty of education of Université de Sherbrooke in 1997, described in his own words the conditions needed for the development of new educational strategies in college, in an article entitled *La construction des connaissances, 2. Les pratiques pédagogiques*. This article, taken from volume 11, no 3, of *Pédagogie collégiale*, in March 1998 (p. 4-9), follows an article published in *Pédagogie collégiale*, vol. 11, no 2, p. 14-22, in December 1997. The first article concludes on a few points of consensus on the construction of learning; the second document outlines the implications of these conclusions for professional teaching practices.

Text 12

Educational changes are long overdue[90]

Ulric Aylwin

Beyond current trends, specific changes are needed in our schools: we must put learning first, use evaluations appropriately and develop linguistic skills in all courses. However, for these transformations to take place we must find ways to overcome the initial resistance to them.

There are two categories of change which will or should take place in our colleges: changes related to the sociological, technological and financial evolution of current conditions; and changes based on the fundamental requirements of good education.

Conditions today have us facing new realities that inevitably involve adaptation and a change in practices. The following facts offer convincing proof:

- a large portion of professors are approaching retirement age and it is necessary to start defining the professional profile of the next generation; socio-economic pressure is also forcing a growing number of people to return to school thereby increasing the diversity at collegial level;
- this clientele, at least in the Montréal area, is increasingly multi-ethnic;
- in addition to cultural heterogeneity, there is a growing disparity in preparation, motivation, age groups and physical conditions of learning;
- the advent of information technologies impacts almost all programs;
- pressure to use these technologies in the classroom is accentuated by the need to prepare students for the market globalization and the impact this globalization has on technology;
- the recourse to technologies is also caused by a drastic reduction in educational funding that leads to human resources being replaced by computer science tools;
- these changes bring about a transformation of our relationship with knowledge, work, students and colleagues;
- recent reform in collegial teaching increases the responsibilities of each school and those of professors in particular, who are now required to create the programs, assess their relevance and value, maintain close ties with workplace environments and universities and focus more on the acquisition of competencies in education.

These are the principal factors likely to provoke a change in the habits of professors.

We consider however, that changes required by current circumstances are likely to be minor or surface changes compared to the real transformations that would follow an in-depth pedagogical revision. We chose therefore to by-pass the minor

[90] Text taken from a presentation given to the Commission de l'enseignement collégial du Conseil supérieur de l'éducation, on December 8, 1995.

ones and focus on clarifying transformations that are long overdue. With transient changes only, we simply continue to mask the serious inertia of the system.

We will initially look at changes needed in instructional relationships and learning evaluation tools as well as the emphasis given to mastering the language.

In the second part, we will examine how to overcome obstacles we encounter on the road to change.

Learning must come first

The fundamental cause of failure in students and poor learning in many graduates is due to an instructional relationship that strips students of their power and responsibilities. The very foundation of pedagogy stems from our concepts on the responsibility of both student and professor, respectively. In fact, the attitudes and practices of the professor and consequently those of the student are dependent on these very concepts.

As a rule, the professor has always seen himself as the centre of the teaching universe. The challenge consists of finding ways to teach professors how to put students in the central role. To accomplish this, we will explore two complementary solutions.

Discovering the real nature of learning

It is not surprising that for centuries, successive generations of professors have recreated the same didactic model of professor-orchestrator. Generally, in the training given to future professors, we avoid examining this model with a critical eye. And, when it is called into question, the replacement formula is usually taught through lectures (unconsciously it seems) i.e., in a totally inadequate way that reinforces the very model we wish to change.

To bring about the desired change, professors must participate in a series of learning activities which will allow them to see, for themselves, the inefficiency of any action that tries to provoke the direct acquisition of knowledge in another. They can then devote their energies exclusively to helping students build their knowledge, by and for themselves.

By going through this discovery process himself, the professor will be able to readily understand the need to stimulate the same discovery approach in his students. We now know that no one can teach anything to anyone. In fact, as Einstein put it, the only thing we can do "is create conditions in which learning can occur."

This point deserves greater reflection. Traditional education rests on a concept that is false, in which we take for granted that knowledge exists outside the brain; that education consists of presenting knowledge to the student's brain (hence the need for teaching); and, that this knowledge is then stored in memory (hence the emphasis on memorization) to finally be recalled from memory, intact at the exact moment it is needed. What seems astonishing is not that our teaching traditions are based on such a simplistic concept of the brain and such a mechanistic concept of learning, but that professors have observed for eons the failure of this strategy. One of their pet complaints is that knowledge, cleverly presented to the student and apparently memorized by him, does not seem to exist when comes the time to recall it (or it exists only in corrupted fragments). Despite this, they continue to try to transfer knowledge into the brain of the student and continue to be indignant when "students seem to have learned nothing in their preceding courses". They get further discouraged when they see that when it comes time to apply knowledge, students "seem to have learned nothing in their theoretical courses either."

To help professors break this vicious circle in which they stubbornly stick to the use of ineffectual education (the error of "more of the same old thing" denounced by Paul Watzlawick), they must recognize that in the brain, no reality exists other than what it perceives; a brain knows or possesses only what it has created or re-created within itself.

This creative activity uses what the brain already knows (David Ausubel) i.e., prior conceptual models of interpretation (Jérôme Bruner) and factors in the unique relationship that the brain has with any new data. And all this takes place at the very moment the interaction is occurring[91].

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[91] For two excellent summaries of the knowledge rebuilding process from a cognitive and constructivist viewpoint, see: IRAN-NEJAD, Ashgar and George E. MARSH II, « Discovering the Future of Education», *Education*, vol. 114, no 2, winter 1993, p. 249-257;

Implementing an active education

The practical consequences of the above are to use active situations where the student is both the central figure and master of his cognitive activity.

These methods allow the student to take charge of his own personal learning. He is in turn supported by a process of discovery and problem solving.

The approach also facilitates exchanges between students and the professor and between the students themselves. One of the most suitable teaching formulas for this type of interaction is teamwork. Teamwork in its most structured and efficient form, known as cooperative learning, is built on the interdependence and personal accountability of all students.

Finally, an active and participative pedagogy presupposes that students assimilate, within each lesson, at least 80 percent of the subject matter covered. If this is not the case, the learning is not sufficiently diversified, differentiated or participative.

The first major change consists in a complete reversal of the traditional instructional relationship. It begins by entrusting the main responsibility for the overall learning process to the student himself.

Using evaluations effectively

The incorrect use of the evaluation is the second cause of failures. Contrary to the widespread practice of using only a few formative evaluations and many summative evaluations, the formative evaluation should be on-going throughout the learning and the summative evaluation should only be given at the end of the complete learning session.

On-going evaluation on the formative level

Formative evaluation is at the heart of learning. The student must be kept updated, at every moment, on his thinking. Is it correct, effective, and thorough? If not, he will not know what knowledge to retain and master. He will remain hesitant on the cognitive level and anxious on the emotional plane.

The primary function of formative evaluation is to have each student validate the quality of his own learning on an on-going basis, so as to correct errors and fill in gaps. This self-evaluation includes feedback from the professor, and is an essential component of education centered on student participation. It is only through the student's own active participation that his knowledge will grow and be consolidated. (At the well-known Alverno College in Milwaukee, *assessment as learning* is the basis for all education.)

IRAN-NEJAD, Ashgar, «Constructivism as Substitute for Memorization in Learning: Meaning Is Created by Learner», *Education*, vol. 116, no 1, Fall 1995, p. 16-31.

The second function of the formative evaluation consists in reassuring the student on an emotional level. When the student knows that he himself is master of his learning, a certainty he will acquire as he progresses on his own, this will become the basis for a strong and positive self-image.

Traditionally, ongoing formative evaluation is not used by many professors, so mindsets have to be changed in order to introduce this practice. The battle will be won, so to speak, when the first transformation has taken place i.e., when education is centered on student participation. But even then, two obstacles can remain.

Initially, the professor thinks the evaluation is too complex for the student and that he will be obliged to administer the evaluation, every week, or even every day. He is already overloaded by his course preparations and the burden of the summative evaluations. However, with arguments supporting the fact that students who are trained, can assume alone or in a team, most of their formative evaluations, professors can be made to realize that there is no extra burden of corrections.

A second obstacle, often considered insurmountable, is time. Professors will usually ask: "I hardly have time to 'cover the course content', how do you expect me to devote half of 'my time' to formative evaluations?"'

The solution is for professors "to try it for themselves", that is, to experience a teaching approach that includes frequent evaluations, does not hinder progress and yet produces great results. Professors will quickly be convinced. One result worth stressing is the increase in motivation. When the student is continuously updated as to his level of mastery, he keeps close tabs on his chances of succeeding in his studies and ultimately, in his future career.

The summative evaluation at the end of learning

The introduction of ongoing formative evaluations allows for and implies the abolition of on-going summative evaluations, since the goals and effects of the former are often in conflict with those of the latter. The use of the summative evaluation should be limited to its specific role, that of an overall assessment at the end of the course when the total sum of learning has been achieved.

Unfortunately, this is more difficult for professors who use grades as the carrot and stick to motivate students. Our teaching tradition is not based on intrinsic motivation. The consensus is that school is a place to go to "prepare for life". It is not a place to joyfully learn and strive for personal growth or acquire what we need to build our own future. We share a misguided belief that courses will bore students and that we must motivate them with rewards and punishments i.e., good or bad grades entered on a report card.

This type of behaviour achieves nothing. Rather it slowly destroys the professor-student relationship as the professor is no longer the guide and resource for personal growth but the judge who grades and holds the student's future success in his hands. It also destroys a positive attitude towards knowledge: when my learning is conditioned by grades, I am no longer interested in philosophy because of what it can teach me about myself or life, but rather because of the grade I need. To summarize, when emphasis is placed on continuous summative evaluations, the student becomes dependent on external motivation[92].

The solution is to encourage professors to use a variety of pedagogical means to awaken intrinsic motivation in students rather than relying on the ineffective validation of grades.

It is a complete reversal: from a scarcity of formative evaluations and omnipresence of summative evaluations, to on-going formative evaluations and summative evaluations at the end of courses only.

Develop language skills in all courses

There can be no intellectual growth or academic achievement without mastery of the language in which the learning takes place. Moreover, there is a strong proven relationship between academic and linguistic competency. Generally, student failure rates coincide with poor performances in language skills. The goal here will be for professors in all disciplines to ensure students acquire adequate mastery of the language.

This implies that professors encourage students to use language as a means of mastering the discipline. It is a gross misconception to presume that competency in a discipline can be acquired apart from the language in which it is written. Since knowledge is contained in words, professors of all disciplines are first and foremost, language professors. It is in the sequencing of these words that we find the syntax of concepts and the structuring of ideas. A professor who gives minimal attention to the quality of a student's expression can expect minimal mastery of the discipline.

Most professors recognize the need for students to master the language, but then they come up with a number of practical reasons for not being able to address this need. Some affirm "There is no time to deal with language in addition to the content which is already overwhelming." Others reason: "We are not experts in grammar." All agree they cannot "add more evaluations while already collapsing under the burden of corrections". How can we overcome these objections?

The first solution lies in the implementation of active education where the student speaks out and frequently writes about various elements of the subject matter. Thus, language is not "additional course content" but the spoken and written words at the heart of learning.

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[92] For a more detailed discussion of the respective roles of formative and summative evaluations, refer to: AYLWIN, Ulric, «Apologie de l'évaluation formative», *Pédagogie collégiale*, vol. 8, no 3, mars 1995, p. 24-32.

A second solution appeals to those who fear they are not language specialists: to stress the meaning of communication rather than the spelling and grammatical correctness. Professors of disciplines other than linguistics may feel inadequate when it comes to grammar and conventional rules of conjugation and syntax. However, all professors in all disciplines are undoubtedly experts when it comes to the meaning behind the words (semantics) of their discipline; and, the organization of words (syntax) used to present the knowledge. In this sense, they are specialists who can use their knowledge to help students master the essence of the language of their discipline.

As for the burden of corrections, we have already countered this objection by explaining how the student assumes responsibility for his formative evaluations.

We are looking at three transformations: active education, ongoing formative evaluation and mastery of the course language in each course, whose importance is not due to the current situation. They are long overdue but risk being overlooked once again in favour of minor changes related to current circumstances. We know that the more a proposed change impacts the instructional relationship, the more we turn away from it and remain content to pat ourselves on the back with the adoption of changes that are less compromising on a personal level.

This leads us to examine the reasons for refusing to effect real transformations. These reasons are extremely varied in nature and it will be necessary to reflect thoroughly on them. For now, we will try to clarify a few elements of mental processes that nourish resistance to change.

In our attempt to understand the intrinsic resistance professors have to change, we identified five obstacles to the creation of a new teaching landscape.

We do not see the need for change

As we saw earlier, teaching methods tend to vary little from professor to professor with quantitative and qualitative results that are also similar. This state of affairs seems satisfactory to many. In spite of low success rates and the questionable competency of graduates, this does not necessarily disturb, as it should, our dominant teaching serenity: After all, are we not using “tried and true” methods? And, since there are so many failures, is this not proof that we are maintaining high “standards of quality”?

To overcome this first obstacle and shed light on this psychological blind spot, we could perhaps notify professors of an impending partial or complete elimination of their programs, as was the case at Alverno College. Research on change has shown that organizations often agree to in-depth changes only when their very existence is threatened.

One thing is certain: we will not make any changes if we remain convinced that everything is right with the world. Change goes through a period of imbalance — a threat, a dissatisfaction – where reflection "obliges" us to seek new ways of doing things.

We do not want to negate the past

Let's suppose that we have been shaken by the statistics on student failure and by the results of teaching methods other than those we are currently using; and let's suppose that we agree to undertake major changes. We may still be unable to act due to an internal dilemma that asks us: Will I stick to my old habits knowing that this is not appropriate, or will I actively participate in the change and live with the unpleasant knowledge that I have been less than completely competent in my role as professor?

This cognitive dissonance, this contradiction between what we think and what we do is one of the greatest obstacles to change. It is painful to opt for a future personal image that is detrimental to our current or past self-image. However, this dilemma disappears if we work towards developing elements of quality and effectiveness that are not currently present in our practices and, if we recognize that the changes are based on acquired competencies that will increase in effectiveness within the new teaching perspective.

This perspective is however, not always visible and can become the third obstacle.

We do not have replacement models

If he overcomes the stage of cognitive dissonance and decides to transform his teaching style, the professor then faces a question for which he may not have an answer: how to bring about the desired changes?

Let us examine the most current situation where teaching is centered on the professor, who monopolizes cognitive operations and speech. Let us suppose that this professor has now decided to focus the attention back on the students. The immediate difficulty is the absence of tools to achieve this ambitious goal. The only teaching formula that the professor masters is the presentation. So he may fail when he tries to incorporate an active method such as teamwork, because teamwork is one of the most difficult formulas to implement. Consequently, if he is disappointed with the results and frustrated at having tarnished his self-image, our noble educator will probably return to the "good old ways".

To avoid this setback, we must provide the professor with sufficient training on teamwork, with concrete situational models and detailed outlines, and make sure there is adequate support /follow-up during the learning process. Without such provisions, failure is likely to "burn" a professor who is already fearful of the new changes. On the other hand, many succeed in contemplating a new strategy that will profoundly renew the instructional relationship; it remains to be seen whether this awareness will lead to action.

We do not have the required energy

It may be that a professor has the right attitude and necessary competency to eagerly embrace a renewal of his teaching style but cringes when he sees the work to be accomplished.

Those who have not experienced this will find it hard to imagine how much effort is required to make a 180-degree change in direction. And this is exactly what is needed to change from a lecture environment to one where students assume control of the learning process. We must plan for continuous application over several years that will consume many evenings and holidays and require a lot of emotional and mental energy.

Given that many professors are currently close to the retirement, they wonder if the effort is worth it, if it is wise to invest in such a lengthy preparation for such a short period of time. Not to mention that teaching reform at collegial level has already increased the workload. So, change must be supported by the greatest possible number of tools and also by work teams whose members share tasks and benefit from the diversity of individual skills. However, what to do about colleagues up to now have not shown any inclination toward change?

We are up against the resistance of others

A considerable number of professors have a preconceived idea of what good teaching is, and given that this idea naturally coincides with their teaching practices, they severely criticize anything that deviates from this orthodoxy. This criticism is directed particularly at young professors who want to innovate, and is an undisguised threat to any professor whose status is precarious.

Resistance is no less keen on the part of many students. They have discovered the advantages of passivity throughout their school years, and are now locked in a routine where they do the least possible amount of work. For these students, having to deal suddenly with their own learning is a rude awakening and they often react strongly against it.

To consolidate the position of the professor in this doubly difficult context, it is necessary to provide strategies that reduce or prevent the opposition of detractors on one hand; and on the other, offer unequivocal support within a clear and stable framework.

The five obstacles which we have just examined are some of the factors influencing resistance to change. We must now analyze in greater detail the mental mechanisms that keep us rigidly tied to an old paradigm, and explore the paralyzing effect that social pressure exerts on professors.

All of the above reasons point to the fact that a deep transformation of education on a broad scale is impossible without a systemic approach.

Conclusion

If we want to make sure that students graduating from college have acquired a true education, it is time to carry out certain changes beyond the superficial ones linked to current circumstances. These changes are at the very heart of the professor-student relationship. They allow the student to be responsible for his own learning as well as his control over his evaluations and his mastery of language skills.

There are many major obstacles to these changes. However, there are also a number of solutions.

With a true educational vision supported by suitable and enduring strategies and the assistance of all agents of change, I am firmly convinced that these changes will take place.

For sceptics who doubt the proposed transformations will ever occur, we refer to the words of Guillaume d'Orange:

"*You can endeavour without having hope, you can persevere without seeing success*."

Text 13
Beliefs which prevent professors from progressing

Ulric Aylwin

The beliefs of professors regarding the capacities of their students and the course content to teach can be a great hindrance to the improvement of education.

Before examining how beliefs can create obstacles to change, we would like to clarify the relationship between the three elements of our initial proposal: progress, professors and beliefs.

- The first question to ask is why we want to progress. Quite simply, we want to progress because we want to live a stimulating life. Given that stagnation is impossible in a living being, the only alternatives available for a professor, as regards his teaching, is to grow or regress.

  On a personal level for the professor, progress achieved in teaching will translate into enriched intellectual activity and a more satisfactory emotional life. On the professional level, it will result in greater effectiveness with students. However, professors who do not undertake ongoing personal or professional growth find themselves in a state of deterioration that can lead to *burnout*, a phenomenon happening more and more frequently in the educational environment.

Improved teaching practices in our educational establishments meet several of society's needs. First, the need to urgently decrease the number of dropouts and the resulting negative consequences for family and society as well as the damaging effects on a personal level. Secondly, to implement approaches that will enable deep learning and critical thinking in students. Finally, it is important to teach our children how to live and cope with the 'accelerating world' in which we live, where science, technology, ideas, culture and societies change at dazzling speeds. We also need to help them acquire attitudes and tools they will need to cultivate new values amid the chaos left behind by generations of bewildered minds.

- It may seem unusual to approach educational progress from the professor's perspective only. Certainly, changes in education depend on many interdependent factors: social climate, cultural trends, the kind of leadership exercised in the educational environment, available resources, current teaching models, characteristics of the students themselves, and various other elements contribute to accelerating or slowing down improvements in teaching.

  However, among all the factors that influence student development, it is the professor who remains the principal agent. The professor-student relationship is an extension of and can even surpass the parent-child relationship because the tasks requested by the professor cause the student to think, to structure his knowledge and to build the foundations upon which his destiny rests.

- We have selected the realm of beliefs because of all the factors that support or inhibit the evolution of a professor, his personal concept of education and his attitude towards change is what motivates his decision to stagnate or move forward.

  Our actions are subject to our way of thinking and this truism has been demonstrated by many schools of thought, psychology, psychoanalysis and neurolinguistic programming, transactional analysis, gestalt, and the rational-emotional approach. This fact corresponds to our personal experience as well as to our observation of others, so we can all agree with Sylvie Tenenbaum who says "It is our system of beliefs that gives meaning to our life, helps us understand our environment and orients our thinking"[1].

  After thirty years of consultation with professors, I noticed that the refusal to carry out a change is generally not because we are unaware of its value, or unaware of how to achieve it, but rather because we do not believe. We are not convinced of its importance or even of its value in the educational community, or that it has anything to do with personal accountability, or that it is even compatible with our concept of instructional relationships.

  On this very subject, Renate Nummela Caine and Geoffrey Caine, in a recently released book, underline the fact that while trying to introduce elements of active education in teaching practices, they were led to conclude that the ability of a professor to use various teaching approaches depends on his worldview or belief system[2].

I suggest we examine two categories of beliefs:

- Beliefs relating to the abilities of the students;
- Beliefs relating to the connection the professor has with the subject matter

We will discuss beliefs on academic success, intellectual competency and personal commitment.

School failures are inevitable

It is remarkable that most professors do not share Pygmalion's belief with respect to the possibility that all students can succeed. Pygmalion is the George Bernard Shaw character who was convinced he could transform a 'savage' into an educated and refined lady of the world – he succeeded! Most professors are convinced students will fail their courses, a prophecy that inevitably comes true. This attitude is based on two sub-beliefs.

[1] TENENBAUM, Sylvie, *Nos paysages intérieurs*, Paris, Interéditions, 1992, p.18.

[2] CAINE, Renate Nummela and Geoffrey CAINE, *Education on the Edge of Possibility*, Alexandria, ASCD, 1997, p. 221.

The first belief takes for granted that collegial-level studies require intellectual capacities that some students do not possess. Therefore professors feel justified in adopting the three following attitudes: one, they find it acceptable to set the level and rhythm of the course according to average or strong students, and to encourage weaker students to look elsewhere; two, they do not believe it is their responsibility to use teaching tools to assist students with difficulties; and thirdly, they do not recognize the need to differentiate teaching to take into account the variety of learning styles, tempos and other particular needs of the learners.

The second sub-belief is based on the concept that it is normal for some to fail and in fact, it would be impossible for all to succeed. This concept arises from the belief that it is the college's responsibility to measure the ability of students and to discourage those who are "too weak". This point of view has a double consequence.

First, we refuse to perform evaluations based on criteria – whereby the performance of one student is not linked to the performance of his fellow students, and individual results are measured in relation to an objective standard established in advance. Instead, we limit ourselves to comparative evaluations with distribution curves for grades, normal curve of probability or Gauss curve, which places students with weaker outputs in a position of failure.

In addition, many professors believe that to be considered 'serious', or even 'competent', they must fail a certain number of students and maintain an 'average' grade for their groups. In fact, just as we are concerned when a professor fails too many students or has low averages, we also immediately assume that a professor is too soft of or not demanding enough if his groups have an average hovering around 90%, and if all his students succeed. Such a belief can lead to strange reactions; for example, in one department at one university in Québec, any professor who gives an A to more than half of the students in his class must appear before a committee to defend his teaching practices.

Students do not have the cognitive capacity to evaluate and correct their own work

We are not referring here to the summative evaluation done for purposes of official validation in the report card, and which is the exclusive responsibility of the professor. We are referring to a formative evaluation of various student productions. Believing the student cannot evaluate and correct his own work has essentially three harmful consequences.

Initially, this belief obliges the professor to evaluate by himself all the work of the students, since he considers himself the only person qualified to evaluate the work of his students. This is a crushing burden of corrections and, even worse, it deprives the professor of time he may need to create new teaching strategies and tools.

Then, eager to reduce the burden of corrections, the professor tends to reduce the scope and number of evaluations which in turn reduces the amount of on-going feedback the student should receive on the quality of his learning.

Lastly, and this is by far the most serious consequence, the student is thus denied an essential part of learning, that is, the self-evaluation of his cognitive capacities.

The majority of students do not spontaneously commit themselves wholeheartedly to their studies

The advocators of this viewpoint are persuaded that only a minority of students are driven by an intrinsic motivation that pushes them to give the best of themselves to their studies. This perception influences the instructional relationship in three ways.

Initially, we systematically resort to grades to validate the efforts or behaviours of students, convinced that “if we do not pay them with grades they will not do the work”. However, as we know, this practice translates into a heavier burden of corrections for the professor.

A more harmful consequence of this systematic barter of grades for a little work causes a major deterioration of the instructional relationship. The professor’s pleasure of sharing his knowledge, experience and passion for the subject matter with students; and the student’s desire to learn and the joy of learning, are transformed into a cheap bargaining relationship where each seeks to gain the most while giving the least.

Lastly, and this has a harmful consequence in the medium and long term, the student who is accustomed to investing energy only in relation to the grades desired, increasingly limits his intellectual ambition and desire for personal development to what “counts on the report card”.

As we can see, the beliefs we have on student capacities for success, competence and motivation have a concrete, deep and ongoing impact on teaching practices. Other effects will become apparent as we examine beliefs related to the subject matter.

Beliefs related to the connection the professor has with the subject matter

The global belief is that it is imperative for the professor to teach a specific content and that he can succeed in doing so.

We must teach everything that is listed in the program

This first conviction has a number of teaching consequences.

We do not dare prune the contents included in the program

We know that every discipline comes down to a few key concepts from which secondary concepts emerge. It thus follows logically that teaching and learning activities should be centered on these basic concepts, and that detailed secondary knowledge (in general very abundant) should be relegated to a secondary role - and to whatever time remains, mainly because students are unable to assimilate this data at high speed, forget it very quickly, and are able to easily locate it, if necessary, in data banks and other sources of information. This opinion however is not shared by a professor who believes he must transfer all the contents in the program and thus places himself in a position of rigidity without leaving any room for manoeuvring.

In situations where we must choose between content and student needs, we sacrifice the latter

The standard and constant response of those who refuse to free up space in their teaching to meet the needs of students with learning difficulties is lack of time: "I would like to go over their work methods with them, but I have a course content to cover. I realize that such an approach would be ideal, but the subject matter that I have to cover does not allow it… ". In short, the learning needs of students cannot prevail over the "constraints" of covering course contents.

We do not take the time to fill gaps in previous learning of the students

A professor, who feels he has only enough time to cover the subject matter of his course, finds it impossible to embrace an approach that requires him to step back in order to jump ahead. He says he does not have time, and that it is not his responsibility to fill in the gaps in the previous learning of students, even if that would enable him to consolidate the bases on which he builds his course. This attitude spells bad news for those in whose brain the knowledge he piles up continues to break down.

We deny our responsibility as concerns basic education

The first element of basic education is the mastery of communication skills, both oral and written. Everyone agrees that this mastery of linguistic skills cannot be acquired without exercises and tests in all disciplines. We should therefore give this fundamental competency the time and place it requires in each course. But most professors will tell you there is not enough time to cover the subject matter, so there can certainly be no question of integrating additional elements of linguistic mastery.

The same excuse applies to other elements of basic education: the development of cognitive capacities - reasoning, critical analysis, decision-making, problem solving, the development of professional work methods and social interaction skills and the development of a personal value system.

This widespread 'I give up' attitude means that the most fundamental element in the education of students is entrusted to what we could call “phantom professors”, who apparently provide this fundamental learning in some unknown magical space/time continuum.

We withhold formative evaluations

Each student should be frequently confronted within each course period with some form of formative evaluation of his cognitive capacities so that he may progressively correct errors and consolidate acquired knowledge.

The information which results from formative evaluations is just as important for the professor who must constantly reorient his strategies based this information. Unfortunately, in the mind of many professors, these evaluations or rather their concept of these evaluations would take up way too much precious time they need to cover course content.

We limit the use of active methods

We generally acknowledge that exchanges in sub-groups, discussions, teamwork and any other tool where the student can handle the learning tasks himself – in various ways and frequently - are good opportunities to acquire deep knowledge. However, from the viewpoint of the person who is preoccupied with covering all the subject matter, the problem is that these methods cut into teaching time, and therefore they can only occupy a very limited role in the overall teaching process.

We prefer the professorial lecture

It has been shown that using a presentation formula makes it possible to quickly and clearly present a great number of concepts. It also ensures total control over the contents and the quality of information provided to the student. This has undoubtedly reinforced many professors in their belief that a presentation is the best means of transmitting knowledge. Consequently, it also leads them to generally refuse to try any form of active learning.

To summarize this aspect of the relationship between the professor and the content of his teaching: a professor who considers himself a repository of knowledge on the content to be taught and who believes that only he must transmit the contents, finds it impossible to make room for other educational elements and for changes required to adapt to obstacles encountered along the way.

We really can ‘teach’ the course content

This second belief masks a major conviction that we carefully avoid acknowledging. The belief is that knowledge is an object and the student’s brain is a container which stores this knowledge. It is from this container that the student will “draw” the knowledge he needs, when he needs it.

This notion of knowledge as an object deposited into a container reveals itself in the metaphorical language used: "I have a content *to pass on"* evokes the notion of an object being passed along. "There is *too much* content" refers to the idea of mass or quantity of objects; "the students *are overwhelmed"* evokes the image of a container that is too full; "the program *is overloaded"* evokes the image of a stacked pile of objects. We could pursue our analysis with other expressions that convey the notion that knowledge is an object having its own existence apart from the brain. Such a belief impacts and orients all the decisions and actions taken by a professor who embraces it.

The first consequence of this model of knowledge is that we believe we can "place" as many concepts in a course as course hours allow, which means the students are thought to store information like an encyclopaedia. It also implies that the professor can "feed" subject matter to his students until they reach a "saturation" level and are in danger of "overflowing". This explains the common practice of introducing many concepts in the first hour of the course – when brains are fresh i.e., empty - and, in the second hour, to review the subject matter now accumulated in the brain of the students through practical exercises.

The second consequence or conclusion is that learning can take place as long as the knowledge is selected with care, well structured and presented with clarity and precision. Naturally, this requires the competency of an expert. And for many, this justifies the fact that many professors monopolize over 80 percent of the time used to speak in the classroom[3].

In addition to the belief that it is possible to transmit knowledge, is the belief that knowledge taught with clarity, order and precision will reappear in the brain of the student in the same clear, ordered and precise manner. This belief further implies that the quality of the students' intellectual operations directly reflects the quality of the intellectual capacities demonstrated by the professor in his lectures.

We would like to insist on the fact that, of all the erroneous beliefs professors adhere to, believing that knowledge is an object which exists apart from the brain of the person who conceives it, is by far the most harmful. We now know that the brain constructs information based on its own conceptual models[93]. It is also harmful and erroneous because it radically hinders the implementation of effective teaching methods that would enable the student to master his own learning process and would enable the professor to assume his rightful role, that of creating situations to facilitate the progress of the students.

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[3] An analysis of video recordings of 200,000 hours of teaching in 42 American States and 7 other countries revealed that for all school levels, the professor spoke more than 80% of the time. Refer to A.H. GRIFFIN, «Thinking in Education Yesterday, Today and Tomorrow», *Education*, vol.106, no. 3, p.268-280.

[93] IRAN-NEJAD, Asghar, «Constructivism as Substitute for Memorization in Learning: Meaning Is Created by Learner», *Education*, vol. 116, no 1, Fall 1995, p. 16-31. PAUL, Richard W., *Critical Thinking: What Every Person Needs to Survive in a Rapidly Changing World*, Sonoma, Sonoma State University, 1990.

The idea of education that allows the student to master his own learning and where the professor's role is to create appropriate learning situations is not new.

- I do not teach my students anything; I only try to create conditions in which they can learn. (Albert Einstein).
- No man can reveal to you aught but that which already lies half asleep in the dawning of our knowledge. (Khalil Gibran).
- You cannot teach a man anything; you can only help him find what is hidden within himself (Galileo Galilei).
- To teach someone something is to deprive that person forever of the possibility of discovering it. (Jean Piaget)
- If you teach a person something, that person will never know it. (George Bernard Shaw)

He who "loses" wins

Before concluding, it is essential to clarify two points in connection with all that has been covered previously.

First, it was mentioned that the reservation many professors have with using active education comes from their belief that this pedagogy would force them to prune the contents of their subject matter, something that is unacceptable to them. What was not mentioned, however, is that the dilemma of respecting the requirements of the course contents or respecting the requirements of an active education is a false dilemma. Truth is, active education does not cause a reduction in course content but rather makes it possible to cover two to three times more subject matter. Such is the reality we observed in the teaching of various disciplines, at various school levels.

Secondly, in the same spirit, we stated that a professor who refuses to incorporate elements like basic education, formative evaluation and corrective teaching, in order to have more time for the contents of the course, could be led to believe that these elements were indeed competing with the contents of the course as regards sharing the short amount of time allotted. In other words the belief is that these elements would add a general content to the specific content of a given course. However, this would be giving credit to another erroneous belief, since in reality, the more we integrate these elements into teaching, the more time we have to cover the subject matter in depth and in detail. For example, developing a student's work methods makes it possible for him to assimilate more easily what is presented and carry out more study work at home. Similarly, through an improvement of reading and writing abilities, he can more quickly accomplish work demanded of him. For its part, formative evaluation allows him to immediately correct his errors, which prevents him from being slowed down by gaps in the sequence of his learning.

Thus *in reality,* we can gain time for the course content by agreeing to lose some, *seemingly*, for the benefit of an active pedagogy and fundamental education.

At the end of our reflection on how beliefs impact change, we must admit that there are many concepts worth examining that relate to student abilities and the relationship between the professor and the content of his teaching. It would be necessary to analyze, among others, beliefs dealing with:

- the role of emotions in learning and teaching;
- the relationships with colleagues, administrators and other players on the educational scene;

- the role of schooling in society;
- the functioning of the brain as well as the way in which we learn.

We would then see even more clearly that all our thoughts, decisions and actions are based on our personal beliefs.

In conducting our study, we could have proceeded differently, i.e. we could have started with a description of teaching practices and worked our way backwards towards the beliefs from where they originate. We could have wondered, for example, what belief encourages a professor to carry out a synthesis at the end of a course, or which belief leads him to determine the criteria with which the work of the students will be evaluated, or which belief underlies the fact that he is spontaneously the first one to answer the questions asked by the students, and so on. No doubt, such an analysis would probably have uncovered some disturbing postulates.

What remains to be done, in addition to the work which we have just discussed, would be to find ways by which we could change our beliefs. For example:

- We could use metaphors to encourage an examination and transformation of beliefs. We could say that the professor is like a gardener (who knows very well he cannot grow in the place of his plants), or like a master chef (it does not come to his mind to want to digest the food he is serving), or like an orchestra leader (the only way he can improve the performance of a musician is to make suggestions on the way he executes his movements), or like a doctor (each of his patients heals in his own way using his own resources). There are many metaphors capable of showing the absurdity of many current practices in education.

- We could also ponder the results of cognitive research which clearly shows that the only knowledge a person possesses is that which he himself constructs or rebuilds (usually unconsciously).

- We could perform an introspective review on our own learning processes to confirm the validity of the cognitive theses.

- We could eventually lend ourselves to a progressive experimentation of certain changes, in order to realize that they are achievable and do produce convincing results.

Basically, it is up to each individual to develop a strategy to facilitate his own pedagogical transformation, taking into account the obstacles he has to surmount and the conditions for success that must be in place.

In conclusion, we recognize the difficulties inherent in making changes in education, because the professor must maintain a positive self-image throughout the process and defend this image vis-à-vis inquisitive looks that may be focused on him. The teaching profession is undoubtedly one of the most highly scrutinized, by students, colleagues, administrator, parents; and lastly, a biased public.

We also have to understand that making educational changes brings into question the professor on all levels: his values, models, education, limitations, practices, knowledge, emotions, skills, network of relationships, everything. So there is a justifiable concern and uncertainty in deciding to commit to significant transformation.

Still, it is necessary to go forward! We are the first generations of professors, in the history of education, to collectively acknowledge that changes are necessary; we know why and how to bring them to fruition. There is one condition of course, and that is not to allow ourselves to be stymied by paralyzing beliefs.

In the end, these changes must be carried out for the good of humanity of which we are a part, for the future of our children and, above all, for our own personal happiness!

Text 14
The construction of knowledge
2. Teaching practices

Jacques Tardif

In this section the author discusses the implications on teaching practices that result from the generally accepted conclusions on the construction of knowledge. They are:

* Professors play a key role in the motivation of students;
* They exert a great influence on learning strategies and the study habits of students;
* They must intervene frequently, systematically and rigorously to ensure the transfer of knowledge;
* Learning is primarily a personal construction resulting from active involvement;
* The personal construction of knowledge rests essentially on the student's prior knowledge;
* Learning inevitably carries the stamp of the initial context in which it was acquired;
* Learning is meaningful in that (1) it challenges the student, (2) results from a cognitive conflict, (3) allows for the establishment of a new equilibrium and (4) can be used for comprehension and action beyond the schooling environment;
* Knowledge is more functionally re-usable when it is:
    * organized hierarchically in memory;
    * linked to cognitive strategies and guided by metacognition.

***The new paradigm in education requires that professors make major changes to practices with regard to teaching contexts, course planning and learning support*.**

There is much to say on teaching practices that support the construction of knowledge. These practices consist primarily in translating principles or concepts into action. From this translation comes a whole range of new venues with numerous and required nuances. I will limit myself here to a few. I will also provide means of intervention for professors. The first part relates to the characteristics of teaching contexts that have a strong influence on the construction of knowledge. The second part deals with the preferred axes for activity planning and the third part presents the broad outline of a teaching practice centered on the support of learning.

Teaching contexts

At the outset, it is important to underline that the complexity of learning situations greatly influences the dynamics of knowledge construction and the development of competencies. For example, learning a mother tongue is an extremely complex interaction between various competencies. The learning occurs in an environment characterized by a high degree of complexity. In this development process, the child is not initially fed theoretical or declaratory knowledge so that he may later proceed to action via procedural and conditional knowledge. Instead he is integrated into an environment which uses language for communication. In the development of these linguistic competencies the child is given feedback by the adult. However, if he were not confronted by this complexity, it is unlikely that the child would succeed in mastering all the linguistic competencies. The poor results of teaching a second language in a school environment support this conclusion. Moreover, we should keep in mind that stuttering/stammering in children often results from situations where learning the mother tongue is initially declaratory before being procedural.

The need for **complexity** is a first characteristic of teaching environments that meet the requirements of consensual conclusions regarding knowledge construction. It is not a matter of proceeding from the simple to the complex, but rather the reverse, of proceeding from complexity towards simplicity. Professors provide the support necessary "to navigate cognitively" through the initial complexity and, gradually, the situations or phenomena become less complex so students may construct the necessary knowledge to understand situations and phenomena, and also to act on them. From this perspective, creative situations, projects to be achieved, cases to be analyzed and problems to be resolved offer very appropriate contexts for incorporating this first characteristic.

Contexts characterized by complexity require **entry by competencies**, understood here as being high-level know–how. The competency axis is constantly prioritized and knowledge, whether declarative (what?), procedural (how?) or conditional (when and why?), is at the service of competencies. In these teaching contexts, knowledge is strongly contextualized in competencies. Under the supervision of professors, students must go back and forth between the earliest and the most recent competencies. In essence, knowledge is built within a framework of competency development and there is no separation between competencies and knowledge, just as there is no separation between declarative, procedural and conditional knowledge. As Develay states, "Theoretical knowledge does not take on real significance until it has given rise to practice". Conversely, practice only takes on its full significance when it can be analyzed using theoretical knowledge[1]."

The teaching contexts under discussion here are also characterized by **interdisciplinarity**, by the creation of a maximum number of connections between disciplines. This characteristic follows from what we have just seen. It would be quite unusual for teaching contexts that favour both complexity and entry by competencies to relate to only one discipline. Moreover, insofar as situations and phenomena are imported into the school environment because of their complexity and the meaning they convey, one single discipline could not provide adequate and proper understanding of these situations and phenomena. It really does not matter whether we are referring to the professional or pre-university sectors, the overall logic of the profession or the program prevails over the logic of each discipline.

In teaching contexts supporting the construction of knowledge, **theory does not necessarily precede action**. It frequently happens that action – the search for a solution to a problem, the taking into account of various factors in a case study, the consideration of various scenarios in the realization of a project, or the grouping of several components in a creative approach – needs to resort to some theory. The reverse can also be true. Theory and action are in constant interaction. Theory allows for better

[1] Develay, M., *Peut-on former les enseignants?*, Paris, ESF, 1994, p. 119

planning of the action as well as more adequate and calculated objectivity. Action ensures the contextualization of theory and brings about adjustments relative to the use of knowledge as a tool. It is important to stress that when theory precedes action, the learning paradigm only requires the data relevant for the teaching situation in question, contrary to the teaching paradigm where professors aim for completeness. The relevant data corresponds to the elements which are necessary and adequate to correctly understand and implement a sound and considered approach.

The learning paradigm forces us to pay a great deal of attention to **the relevance of evaluation practices**. By taking into account that methods and contents of evaluation largely determine the orientation that students give to their learning, it is necessary to seek a high degree of coherence relative to the evaluation in a context focused on the construction of knowledge and the development of competencies. In such a context, the first goal of the evaluation consists in identifying the cognitive and socioaffective changes which occurred in the students due to their involvement and perseverance. The evaluation aims at identifying the metamorphoses experienced by students and, if necessary, to allot values to them. In such an orientation, it is not uncommon to use a portfolio as a continuous form of evaluation, just as it is not surprising to note that the borders between formative evaluations and summative evaluations grow blurred and finally disappear insofar as the objective of both is to place the student on a path of development.

Lastly, it is important to **systematically reserve time for the transfer of knowledge**. Periods of re-contextualization must be included in the students' schedule. In the teaching paradigm, the dominant concern for the professors comes from the need to cover all the subject matter within the program. This concern pressures professors so that many make it a point to expose the students to the overall course contents, without being concerned about student mastery of the subject matter and without paying attention to the quantity and quality of the knowledge constructed and the competencies developed. What is most worrisome, however, is that some professors allow the students to stop studying once they have covered the contents of the program. These two attitudes are typical of a teaching paradigm, but far from a learning paradigm. In the latter, professors believe that competencies continue to be developed and that re-contextualization contributes to a higher degree of student mastery of knowledge and competencies.

Instructional planning

As for instructional planning, according to a general consensus, it is important that professors give special attention to several elements. The first element concerns **the time needed for learning**. Within the framework of the teaching paradigm, time is rigidly set: x hours for teaching, x hours for work, x hours for evaluation. Regardless of the quality of the constructed knowledge and competencies developed in the planning schedule, the learning activity stops at a precise moment after a determined period of time. In the learning paradigm, professors accept that the rate of learning varies according to the students and that, for some, the time allotted is sufficient whereas, for others, it is either insufficient, or too great. In the first instance, it is necessary to plan for specific methods so that students construct the knowledge and develop the targeted competencies. In the second case, the solution is to plan for enrichment or deepening activities. We are now implementing differentiated instruction.

When planning the teaching activities, **the choice of teaching tool** most likely to have a significant influence on the construction of knowledge and the development of competencies, is an important decision. In the learning paradigm, as we saw previously, professors plan the learning (1) by basing it on complexity, (2) by favouring entry by competency, (3) by stressing interdisciplinary relationships, (4) by creating constant interaction between theory and practice, (5) by identifying evaluation practices based on teaching practices while pursuing the objective of specifying the cognitive and socioaffective metamorphoses of students and (6) by introducing situations of re-contextualization. Taken in conjunction with the characteristics of the teaching environment, these controls lead the professors to make enlightened choices. In certain teaching fields, learning based on problem solving or projects constitutes the best choice whereas, in others, it can be creative, remedial or conceptual activities. In others still, the most suitable orientation consists of a mixture of research, conferences and projects. It is also important for professors to pay special attention to the methods of evaluating learning, because they exert tremendous pressure on learning strategies and on the study strategies chosen by the students.

Whatever the selected teaching tool, we must carefully plan **how the learning activities unfold.** Because they exert great influence on the degree of motivation of their students, professors must identify the means they will use in order to bring about and support this motivation. It is particularly important for them to insist on the value of learning as well as on the perception that students have of their competency to carry out the learning in question. Moreover, professors must not only plan the activity that will allow them to gain access to the prior knowledge of their students and to validate it, but also to specify the methods of reviewing this knowledge during the unfolding of the activity. They must also determine the times when they will intervene explicitly in the hierarchical organization of knowledge of students. Based on this concern, although it is important to plan various organizational strategies, professors assume the final responsibility for validating the organization of knowledge by the students. Lastly, it is crucial that, during the activity, they set specific periods when their intervention will relate in particular to the establishment of explicit links between a given competency and declarative, procedural and conditional knowledge. Professors have crucial work to do with their students as concerns the recognition of links that exist between knowledge and competencies.

Finally, it is necessary to plan for **integration periods** of the knowledge constructed and the competencies developed within the framework of the activity as well as within the framework of other activities carried out in the program. These integration sessions allow for periods devoted to synthesis which regularly prepare the students for a comprehensive assessment at the end of the program. With this type of planning, the creation of a specific course to prepare for a comprehensive assessment at the end of program loses all meaning. Periods of integration or synthesis are all the more effective when they occur frequently and follow the progression of the cognitive and socioaffective metamorphoses of the students. They present a still a higher degree of effectiveness if professors go beyond the past and the present with their students to create links with the future. In doing so, they establish relationships to future training activities in the program. They also contribute to creating within the students a set of expectations for new learning and for their education as a whole.

In teaching contexts that favour complexity and entry by competencies, the information noted by students - information suitable to be transferred into knowledge in a process of personal construction – is very abundant and diversified. Unless professors create moments to identify the most important information, the student risks not recognizing its importance and, consequently, very little knowledge will be built or it will be built in an erroneous or fragmented way. To avoid this risk, professors must set aside **stages of de-contextualization**. During these activities, students are placed in contact with raw information and are led to examine a portion of the learning under a magnifying glass.

De-contextualization must not however not be carried out without determining the links to competencies. It is necessary to have ongoing interaction between the stages of contextualisation, de-contextualization and of re-contextualization. In this case, it is necessary to establish **explicit relationships**, on one hand, between knowledge and competencies and, on the other, between declarative, procedural and conditional knowledge relating to the same competency. In the spirit of such an approach and in its logical continuation, professors intervene in **the hierarchical organization of knowledge**. If the students' degree of familiarity with the field of learning in question is relatively low, the professors assume most of this organization. On the other hand, if the students possess a high degree of familiarity with the contents, the professors pass on to them the primary responsibility for the hierarchical organization and then determine its validity.

In teaching contexts that favour entry by competency and constant interaction between theory and practice, the students are very active. To support the construction of knowledge in a systematic way, it is important to support **the reflection of students do on their cognitive choices** during the activity. This reflection focuses essentially on the knowledge they use to realize the activity. It is important for the professors to oblige the students to practice this kind of reflection to avoid developing competencies that are automatic unconsidered reflexes or not supported by any principle or theory. Such a teaching requirement requires that students consciously associate their knowledge with activity contexts, thus opening important venues for their transfer.

In the final analysis, **the transfer of learning** is the ultimate objective of the learning paradigm. It is crucial that students perceive knowledge as instruments, tools or resources. According to this perspective, following the example their professors, they are concerned with the viability of their knowledge, that is to say they actively seek to identify situations and phenomena that their knowledge allows them to understand and on which they can act in a judicious manner.
In this sense, students are always invited, sometimes obliged, to identify the contexts in which they could use the knowledge they construct and the competencies they develop. A constant openness to the transferability of learning is an integral part of student education at the collegial level. Professors cannot accept to use it only at the final stage of learning or to attend to it only if time permits.

A final point to be mentioned here relates to the student's commitment and persistence in learning, i.e. **academic motivation**. Given that their active involvement derives from the fact they find themselves in a situation of cognitive conflict, which motivates them to search for a new state of equilibrium, it is fundamental that students be aware of this conflict and ideally be able to identify it. Moreover, it is important that they become aware of the new state of equilibrium they seek and, once the learning in question is over, that they determine explicitly the degree of conflict resolution at the heart of the process as well as the state of their knowledge and competencies within the framework of the new equilibrium. We refer here to activities directed specifically towards the development of metacognitive habits.

A few snags on the horizon

It is not very probable that the transformation of the teaching paradigm into a learning paradigm can be done in a gradual way. Professors like other players in the collegial network, find themselves more in a situation of rupture as regards former teaching and evaluation practices. Specific activity directly linked to these former practices can certainly be imported within the framework of the learning paradigm, but it requires important adjustments in relation to the new practices. In such a context of rupture, there are anticipated snags that are likely to prevent or derail the contemplated change and delay the attainment of a new equilibrium in teaching and evaluation practices. This delay is all the more detrimental given that professors in the collegial network are faced with students who present new characteristics compared with those of the previous decade, and that colleges, like other educational establishments, are experiencing a significant decline in social status.

One snag is due to the origin of the professional identity of professors. Insofar as their identity is exclusively connected to teaching, it will be very difficult to bring about the necessary changes. The learning paradigm requires that they adopt a professional logic or, if necessary, a program logic in the planning of their teaching as well as in the conducting of the learning and evaluation situations. This orientation forces the logic of disciplines to be subordinated to the logic of a profession or to that of a program. If this is not the case, professors will have the impression that the learning paradigm disparages their discipline or places it in a secondary role, and some are ready to initiate an epic battle to avoid this denigration.

Another dangerous snag is the fact that, in colleges, individual autonomy takes precedence over collective autonomy. Collective agreements and the organization of work make it so that professors in the collegial network can, if they wish it, exercise their profession in an isolated way. Thus, the concept of collective autonomy conveys a certain number of very demanding concepts in the educational environment. It implies in particular that professors have responsibilities that go far beyond student success in their courses. They have important responsibilities with regard to the projects of the establishment, the certification of the students in the programs where they teach, and the development of student identity. Within the framework of the learning paradigm, professors form a community of interdependent professionals who share a common purpose, goals, tasks and responsibilities.

One final snag concerns our concept of learning and teaching. References to cognitivism, sociocognitivism as well as constructivism are frequent and, if we rely on what is being said, we could believe that the passage of the teaching paradigm to the learning paradigm is currently in progress. However, daily teaching practices and evaluation practices present another reality. The gaps between talk and action are due, among others, to the concept that professors have of learning and teaching. A certain number still think of learning as a process of associating one piece of knowledge to another, thus favouring fragmentation and sequencing in teaching. This concept of learning gives a very positive value to the encyclopaedic model of teaching. This concept also explains, in part, the reservations, in some cases the allergic reaction, of certain professors towards the integration of information and information technologies at collegial level.

In any event, in-depth changes are essential. And these changes will not be able to be carried out unless professors raise the necessary conceptual and epistemological questions before adhering to ministerial orientations.

Text 15

Adult learning principles in support of learning activities

The following 66 principles are designed to guide the person in charge of student success at collegial level in his organizational work and selection of activities to increase teachers' awareness of New Educational Strategies. These principles come from **Brundage D**. *Adult Learning Principles and their Application to Program Planning*, Ontario Ministry of Education, 1980, pages 21 to 57. They were adapted for professors at collegial level by the originator of this learning kit.

Adult learning principles in support of sensitization activities

1. Physiological characteristics of professors in training

1.1. Professors learn more effectively when they are in good health, well rested and not under stress.

1.2. Professors learn more effectively when their vision and hearing are in the best condition possible and when the learning environment can compensate for any loss of sensory acuity;

1.3. Professors' learning is not directly related to physical changes until after about age 40, except in the case of what might be called rehabilitative learning such as might follow illness or accident.

1.4. Learning difficulties for professors over the age of 40 can often be related to physical aging. These can be difficult to detect; for example, visual acuity may decline almost imperceptibly over a long period of time, and the techniques the adult develops in order to cope with the change may go unnoticed.

1.5. Professors in training do not learn productively when under severe time constraints. They learn best when they can set their own pace and when time pressures are kept to a minimum.

2. The self-concept of professors in training

2.1. Professors enter learning activities with an organized set of descriptions and feelings about themselves which influence the learning process. They have a well defined image of who they believe themselves to be, both as concerns their knowledge and their qualifications.

2.2. An instructor working with professors needs to know how he personally conceptualizes adult learners as well as how the individual adult learners conceptualize themselves. In cases where the two conceptualizations are incongruent, the teacher should pay more attention to the learner's description of himself.

2.3. Professors with positive self-concept and high self-esteem are more responsive to learning and less threatened by learning environments. On the other hand, those with negative self-concept and low self-esteem are less likely to enter learning activities willingly and are often threatened by such environments.

2.4. Professors in training are more concerned with whether they are changing in the direction of their own idealized self-concept than whether they are meeting standards and objectives set for them by others.

2.5. The reaction of professors vis-à-vis certain learning activities depends on how they perceive it, not on how the trainer presents it.

2.6. Professors learn better when the learning activities allow them to organize and integrate new learning into their self-concept.

2.7. The instructor will be able to influence the idea a professor has of him if he values training and considers it an integral part of the professor's life and by underscoring the importance it has with respect to fulfilling his role at work, at home and in society.

2.8. Professors learn better in environments which provide trusting relationships, opportunities for interpersonal interactions with the instructor and other learners, as well as support and security for testing new behaviours.

3. Stress and emotions of professors in training

3.1. Professors in training learn best when they are stimulated by intrinsic motivation that is supported by external sources.

3.2. Professors do not learn easily when over stimulated or when experiencing extreme stress or anxiety.

3.3. The emotions of professors in training have stronger and longer emotional responses to change than do students.

3.4. Professors learn best in environments which provide good relationships and freedom from threat.

3.5. Professors who enter into learning activities are often well motivated and generally do not require further stimulation in the form of pressure or demands from the instructor or other learners. What they may require is support in their desire to learn.

3.6. Professors who are experiencing extreme stress or anxiety may communicate poorly and process information in ways which delete, distort, oversimplify, or over-generalize.

3.7. Stimulation at the start of a course can be channelled equally well into learning or into resistance to learning.

3.8. Professors in training who can process information through multiple channels and have learned how to learn are the most productive learners.

3.9. Professors learn best when the content is personally relevant to them (past experience or present concerns) and when the learning process is relevant (i.e. in touch with the reality they experience in the educational environment).

3.10. Professors learn best when novel information is presented through a variety of sensory modes and experiences, with sufficient repetitions and variations on themes to allow distinctions in patterns to emerge.

3.11. Professors learn better when they play an active role in learning, in particular through effective two-way communications which emphasize learner talking and self-reflecting and professor listening and reflecting.

3.12. Professors in training develop strategies for defending against threat, for covering emotional reactions. These may mask stress or anxiety but never completely alleviate it.

3.13. The consequences of learning can lead to disorientation and conflict. This state of transition or tension is normal in training and usually leads to an improvement in learning and increased mastery of the change.

4. Learning activities adapted for professors in training

4.1. Professors learn most productively when the material being learned or the processes being used bear some perceived relationship to past experience, or when past experience can be applied directly to new situations.

4.2. The past experience of the professor presents him with a paradox. In training, the meanings, values, strategies, and skills based on past experience and forming part of the present self-concept are being changed.

4.3. The learning activities of the professor in training transform the values and the attitudes derived from past experience. This process requires more energy and more time than learning based on the formation of new learning. It also requires that past experience be raised to the level of consciousness; that both figure and ground be examined for relationships; and that new behaviours be tested in safe and trusted environments.

4.4. The past experiences of the professor must be acknowledged as an active component in learning, respected as a potential resource for learning, and accepted as a valid representation of the learner's experience. Past experience can be both an enhancement to new learning and an unavoidable obstacle.

4.5. Professors do not necessarily possess all the meanings, values, strategies, and skills required for new learning activities. Acquisition of the missing components must be regarded as an essential activity in all learning experiences. Assessment of learner needs in this regard should be part of every adult learning experience and should concentrate on identifying each individual's strengths and weaknesses, since every individual will have unique past experiences.

4.6. The past experience of the professor can be most productively employed in current learning when divergent, non-sequential, non-logical cognitive processes, such as analogies and metaphors, are used to connect it to present experience.

5. Length of time and rate of learning of professors in training

5.1. Professors in training focus on the problems of the immediate present. Learning content should be derived from the learner's needs.

5.2. Past experience becomes increasingly important as the professor ages. Its potential for helping or hindering the learning process also increases with age.

5.3. When the learning activity focuses on problem solving, the solutions must come from or be congruent with the experience, potential resources and expectations of the professors in training rather than being prescribed by an "expert".

5.4. Professors in training tend to experience a need to learn quickly. They are often reluctant to engage in learning activities or content which does not appear to have immediate and pragmatic application within their life.

6. Motivation of professors in training

6.1. Certain professors can have a personal motivation to start a learning activity. This motivation will be more or less satisfied depending on the means used during the activity to meet the underlying needs of this motivation.

6.2. Professors with very precise personal motivation for learning are likely to feel more threatened and to require more trainer support and structure and extensive assistance in clarifying and establishing their own directions and goals. This process of clarifying learning needs and goals contributes to feelings of satisfaction or dissatisfaction.

6.3. Once the general objectives are clearly identified, the specific objectives must be formulated so as to provide the professor in training a clear guide of what is expected of him in terms of skills or tasks, so the trainer may provide feedback quickly and easily. This feedback contributes to feelings of success or failure. It also provides real information for the guidance of learning.

6.4. Success and satisfaction reinforce motivation for learning.

6.5. While professors have the verbal capability to clarify and specify their own learning needs, they are often reluctant to do so and may need assistance in the process.

7. Contradictions experienced by professors in training

7.1. As the professor learns, he needs to be able to cope with paradoxical situations in which change and stability, dependency and independency, are all required. In such situations, he needs to be able to use question-asking and -answering behaviours, problem-finding and -solving approaches, an openness to new information, and a willingness to make a decision or reach tentative closure. A diversity of behaviours is facilitated by the trainer who is also willing and able to remain flexible, open to alternatives, and tolerant of ambiguity, diversity, inconsistency, and instability rather than becoming defensive or angry.

7.2. The professor may respond to ambiguity and instability with increased anger and self-defence. Since ambiguity and instability are seen as necessary for learning, frustration will often be a basic component of any learning activity resulting from the necessity for change.

Learning styles and abilities of professors in training

8.1. Professors each have individualistic learning and cognitive styles and mental abilities.

8.2. A group of professors in training will be heterogeneous in terms of learning and cognitive styles and mental abilities.

8.3. The trainer must be willing and able to respect and respond to each leaning and cognitive style and must be aware of his own styles and of how these affect the processes he uses to assist the professors.

8.4. When a mismatch occurs between the learning/cognitive style of the professor and that of the trainer, the result is likely to be unsatisfactory to both.

8.5. When different learning styles are involved in a training activity, there are at least two ways of dealing with the situation. One involves matching the trainer and the professor using the same learning style; the other involves a trainer who is at ease with several learning styles.

8.6. Cognitive and learning styles are value-neutral. There is no "one best way to learn."

8.7. Professors in training tend to be proficient at self-selecting those training and teaching-learning interactions which best enhance their own learning/cognitive styles.

8.8. Learning activities are cyclical, sequential, and unidirectional in their natural order. This process is dependant on the evolution of the situation, the objective sought, the characteristics of the professors involved in the learning situation, and the personality of the trainer.

8.9. Professors in training prefer to start with the learning activities they are most comfortable with and to avoid those they see as difficult.

8.10. Trainers tend to start teaching activities with their own preferred learning activity.

8.11. Professors in training and their trainers can share the responsibility for the learning activities. They can share the responsibility for such teaching-related activities as providing input, creating learning experiences, directing activity, and deciding on directions and objectives.

8.12. Feedback can occur only after the learner has acted overtly. The later the action and feedback come in the learning activities and/or the farther apart the action and feedback are in time, the less likely it is that feedback will contribute to satisfaction and success.

8.13. A teaching style may be adapted to some situations and not adapted to others.

8.14. Learning styles are not related to intelligence, mental ability, or actual performance.

8.15. Usually, towards the age of 50, overall mental ability generally declines; however verbal abilities do not decline and often increase. It is nonverbal abilities that decrease.

8.16. The mental abilities which decline are based on physical factors and on factors involved in the transfer of learning between past experiences and present situations where meanings, values, skills, and strategies seem non-meaningful or irrelevant to the professor engaged in the learning situation. However this reduction in abilities regarding the transfer of knowledge does not occur when the professor considers the new situations to be relevant.

9. Stages in the changes experienced by professors in training

9.1. The behaviour of the professor in training is not fixed, but changes in response to both internal and external pressures.

9.2. The changes include several stages and begin with becoming aware of the need for change. This is followed by a decision to give a new direction to one's action. When positive outcomes result, a period of inner consolidation and integration takes place followed by an anchoring in reality.

9.3. Professors in training are more apt to be responsive to learning during the intervals between transitional phases.

9.4. Professors in training do not achieve all anticipated levels of development. This may be due to their lack of past experience or obstacles encountered in the learning environment during the process.

9.5. Professors in training may also regress due to environmental pressures.

9.6. Professors in training are highly motivated to learn in areas relevant to their current developmental tasks and transitional phases.

9.7. Professors in training undertake changes in response to their self-image. They may also become agents of change due to the expectations of their environment.

Conclusion

Given that the learning style of each professor is dependable, personal and definitely distinct from his colleagues, it is best to maximize access to the learning tools in order to allow for an in-depth integration by each.

Given that each individual retains 10 % of what he reads, 20 % of what he hears, 30 % of what he sees, 50 % of what he sees and hears, 80 % of what he says and 90 % of what he does, it is preferable to use a pedagogical approach which makes the professor the key player in the integration of his own learning.